Stock Annex: Sea bass (*Dicentrarchus labrax*) in divisions 4.b–c, 7.a, and 7.d–h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel, and Celtic Sea)

Stock-specific documentation of standard assessment procedures used by the International Council for Exploration of the Sea (ICES).

Stock	Sea bass (*Dicentrarchus labrax)* in divisions 4.b–c, 7.a, and 7.d–h
Working Group	Celtic Seas Ecoregion (WGCSE)
Revised by	WKBass 2018
Last updated:	March 2018
Last Benchmarked	WKBASS 2018

A. General

A.1. Stock definition

European sea bass inhabits the coasts, estuaries and lagoons of the Mediterranean Sea and Northeastern Atlantic Ocean. Mediterranean and Atlantic fish differ in morphology, life history and genetics to such extent that they may be considered almost subspecies. Atlantic fish occur in the North Sea (area 4–up to 60°N), English Channel (7.d–e), Irish Sea (7.a), Celtic Sea (7.bf–j), Bay of Biscay (8.a–c), off Portugal and Atlantic Spain (9.a), and off the coast of Morocco (30°N). Stock structure of sea bass in the Northeast Atlantic was reviewed by WGNEW (ICES, 2012) and IBP-NEW (ICES, 2012), based on evidence from genetics studies, tagging studies, distribution of commercial catches, stock trends between areas, and information contained in ICES SGBASS reports (ICES 2001; 2002; 2004a; 2004b). Four discrete stocks were identified as: 1. Northern - ICES 4b&c,7a,d–h (Bass-47); 2. Biscay – ICES 8a&b (Bass-8ab); North Spain & Portugal - ICES 8c&9a (Bass-8c9a); and West Coast Scotland and Ireland - ICES 6.a, 7.b, 7.j (Bass-WOSI) (Figure A.1.1).

Working documents summarising studies on sea bass stock identity and movements were supplied to WKBASS (ICES, 2017b). Genetics studies show no evidence of biologically discrete stocks with in ICES division 4.b and c and 7.a, d–h. Two large tagging programmes are underway that will provide significant information on the movements of sea bass and could indicate the levels of mixing between stocks. Behavioural and genetic studies of sea bass are also underway with the aim of investigating the distribution of sea bass within Irish waters and the potential existence of an Irish subpopulation (ICES 2017b). Sea bass movement patterns between ICES stock units are plausible, as evidenced from some individuals tagged with DSTs and fidelity to both spawning and feeding grounds may provide evidence of fine population structure that identified using genetics. However, it is not possible to quantify the proportion of fish migrating between the stocks currently due to the small numbers of fish tracks analysed. As further DSTs are analysed, it may be possible to quantify exchange between stocks, so the next benchmark should consider how exchange between stocks should be incorporated into the assessment process (ICES, 2017b).

There was no evidence of a change in stock delineation provided for WKBASS (ICES, 2018), so stock identity was assumed to be the same as previous descriptions (ICES, 2012) with the following Atlantic stocks:

- Assessment area 1. Sea bass in ICES areas 4.b–c, 7.d–e, 7.h, 6.a, and 6.f–g (lack of clear genetic evidence; concentration of Area 4 sea bass fisheries in the southern North Sea; seasonal movements of sea bass across ICES divisions). Relatively data-rich area with data on fishery landings and length/age composition; discards estimates and lengths; growth and maturity parameters; juvenile surveys, fishery lpue trends. [Bass-47].
- Assessment area 2. Sea bass in Biscay (ICES subareas 8.a–b). Available data are fishery landings, with length compositions from 2000; discards from 2009; some fishery lpue.
- Assessment area 3. Sea bass in 8.c and 9.a (landings, effort).
- Assessment area 4. Sea bass in Irish coastal waters (6.a, 7.b, 7.j). Available data: Recreational fishery catch rates; no commercial fishery operating. [Bass-wosi].

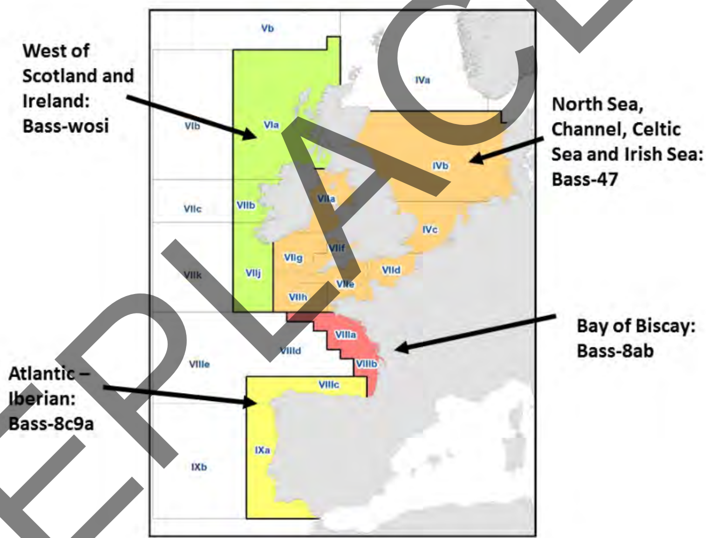

Figure A.1.1. Current stock definitions for sea bass.

A.2. Fishery

General description

The commercial sea bass fisheries in ICES subareas 4 and 7 have two distinct components: an offshore fishery on prespawning and spawning sea bass during November to April, predominantly by pelagic trawlers from France and the UK, and small-scale fisheries catching mature fish returning to coastal areas following spawning and in some cases immature sea bass. In 2016, a total of 1295 tonnes was landed, 772 tonnes less than 2015 due to the EC regulations imposed. More detailed descriptions of national fisheries can be found elsewhere (Armstrong and Drogou, 2014; ICES, 2017a), but a brief summary is provided below.

The inshore fisheries include many small (10 m and under) vessels using a variety of fishing methods (e.g. trawl, handline, longline, nets, rod and line). The fishery may either target sea bass or take them as a bycatch with other species. Historical landings data for the small-scale fisheries are often poorly recorded, but the bulk of the catch can be taken by relatively few vessels. For example in the UK in 2010, sea bass landings were reported by 1,480 vessels (including 1207 of 10 m and under), with 10% responsible for over 70% of the total landings of 719 t (Walmsley and Armstrong, 2012). For France, sea bass landings were reported by 2226 vessels in 2009, including 976 of 10 m and under. Three main métiers were responsible for over 83% of the total landings. Pelagic trawlers (32% of total landings, for 58 vessels and 276 seamen) and liners+handliners (22% of total landings for 416 vessels and 634 seamen) are very economically dependent on sea bass (Drogou *et al*., 2011). French bottom trawlers often do not target sea bass, but this gear does represent 30% of the total landings (832 vessels and 2769 seamen) (Drogou *et al*., 2011). Despite the apparent decline in sea bass biomass indicated by the ICES assessment of the stock (ICES, 2016), landings of UK inshore under 10 m vessels deploying fixed or drifting gillnets have been rising since 2000 with a peak in 2014.

Targeted netting for sea bass and bycatch takes place all around the coast of England and Wales. This occurs both in inshore waters and in some areas such as the Eastern Chanel where netting extends into deeper water to intercept migrating adult sea bass in autumn and early winter. It is not known how the reduction in pelagic pair trawl fishing in 2014 affected inshore fleets in subsequent months, but no effect was visible in the landings by the French artisanal fleets.

The bulk of landings was historically taken by French bottom trawlers and midwater (pelagic) pairtrawlers. The midwater pair trawl fleet targeted adult sea bass on or near spawning grounds in the Channel and Celtic Sea in late winter and spring. Since the mid-2000s, this fleet had shifted more of its activities from the Bay of Biscay to the Channel, increasing fishing effort on adult sea bass in this area. In 2013, the fleet of around 40 French pairtrawlers and a small number of UK midwater trawlers accounted for 37% of the total international landings. However, landings by this métier reduced from 1630 t in 2013 to only 243 t (9% of the total) in 2014 mainly due to poor weather conditions. In 2015, restrictive management measures and the ban of pelagic trawlers led to changes in trends in landings with the expected decrease observed. This reduction has led to French pairtrawlers switching from sea bass to hake.

Almost 50% of the French landings in 2016 were made by bottom trawlers either targeting or bycatching sea bass. A large decrease in French landings of around 50% was observed between 2015 and 2016 (1110 t in 2015; 547 t in 2016). Some French vessels using Danish seines appeared in the offshore fisheries in 2009, but catches are low falling to 18 t in 2016. Seining has also become more prevalent in the UK fleet in recent years although it is a small contributor to total landings. Landings by Belgium and the Netherlands have only appeared in catch statistics since 2000 as fisheries in the North Sea became established following the spatial expansion of the stock.

Sea bass are a popular target for recreational fishing in Europe, particularly for angling in the UK, Ireland and France, and increasingly in parts of southern Norway, the Netherlands and Belgium. Relatively little historical data are available on recreational fisheries although several European countries are now carrying out surveys to meet the requirements of the EU Data Collection Framework and for other purposes (ICES, 2009; 2010; 2011, 2012c; Herfault *et al*., 2010; Rocklin *et al*., 2014; Van der Hammen and De Graaf, 2012; 2015; Armstrong *et al*., 2013).

The market value of sea bass varies greatly with higher values for certain métiers. For example, the mean price of sea bass sold in France in 2013 by liners was €17 per kg compared with €7 per kg for pelagic trawl (SACROIS Ifremer-DPMA), reflecting differences in volume and fish condition. The CHARM 3 Atlas of the Channel Fisheries reports that sea bass production in value represented €31 937 in 2008. It is the third most valuable species caught in the Channel (source: Agrimer) behind sole and monkfish (tuna is not included in statistics).

Fishery management regulations

Sea bass are not subject to EU TACs and quotas, and until recently had limited management measures in place for its conservation. The Minimum Conservation Reference Size (MCRS) of sea bass in the Northeast Atlantic was introduced in 1983 at 32 cm, increasing to 36 cm in 1990 and 42 cm in 2015 (EEC Regulations 171/83, 4056/89 and EU Regulation 2015/523 of 25 March 2015). Other, more general measures included: commercial vessels catching sea bass within cod recovery zones being subject to days-at-sea limits according to gear, mesh, and species composition; and there is effectively a banned range for enmeshing nets of 70–89 mm stretched mesh in Regions 1 and 2 of Community waters[1]. In addition, an area closure around Ireland is in place for commercial fishing (http://ec.europa.eu/fisheries/cfp/fishing_rules/sea-bass/index_en.htm).

Recent scientific analyses have reinforced previous concerns about the state-of-the-stock and advised a reduction in fishing of 80%. In 2015, the European Council adopted emergency measures to help sea bass recover. In addition to the MCRS increase to 42 cm, emergency measures implemented in July 2015 placed: (i) a ban on targeting the fish stock by pair-trawling during the spawning season up until the end of April; (ii) a monthly catch limit (1.5 t for pelagic trawlers; 1.8 t for bottom trawlers; 1 t for driftnets; 1.3 t for liners; 3 t for purse-seiners); and (ii) a daily bag limit of three sea bass for recreational fishing (EU Regulation 2015/523 of 25 March 2015).

Measures introduced in 2015 and updated in 2016 through consultation with Member States and stakeholders, include reduction or prohibition of landings depending on gears and months (Table A.2.1). For recreational anglers, a catch and release fishery for the first half of the year and in the second half a bag limit of one sea bass per day.

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[1] Region 1: All waters which lie to the north and west of a line running from a point at latitude 48°N, longitude 18°W; thence due north to latitude 60°N; thence due east to longitude 5°W; thence due north to latitude 60°30'N; thence due east to longitude 4°W; thence due north to latitude 64°N; thence due east to the coast of Norway.

Region 2: All waters situated north of latitude 48°N, but excluding the waters in Region 1 and ICES divisions 3.b, 3.c and 3.d.

Table A.2.1. Commercial fishery regulations on allowable catches by gear and month in 2016.

2016 measures	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Bottom trawlers	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Seiners	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Pelagic trawlers	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Drift Gillnets	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Hooks	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Lines	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Set Gillnets	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t

Additional to EU regulations, a variety of national restrictions on commercial sea bass fishing are also in place including:

- Closure of 37 sea bass nursery areas in England and Wales to specific fishing methods;
- Minimum gillnet mesh size of 100 mm in South Wales;
- Control measures that effectively ban commercial fishing in Irish waters;
- Licensing of commercial gears targeting sea bass in France;
- Voluntary closed season (February to mid-March) for longline and handline sea bass fisheries in Brittany (may be superseded by new EU measures);
- Restrictions on sale of catch and gear for recreational fishers that vary between countries.

Management applicable to 2017

Scientific advice in 2017 for sea bass in the Celtic Sea, Channel, Irish Sea and southern North Sea (ICES divisions 4.b, 4.c and 7.a, 7.d–7.h) highlighted the perilous state and continued decline of the stock. The conservation measures to prohibit fishing for sea bass are therefore mantained in ICES divisions 7.a, 7.b, 7.c, 7.g, 7.j and 7.k, with the exception of the waters within 12 nautical miles of the baseline under the sovereignty of the United Kingdom. Spawning aggregations of sea bass were protected with commercial catches restricted further in 2017. On the basis of social and economic impacts limited fisheries using hooks and lines were permitted, while providing for a closure to protect spawning aggregations. Additionally, incidental and unavoidable bycatches of sea bass using demersal trawls and seines were limited to 3% of the weight of the total catch of marine organisms with a maximum of 400 kilograms per month. Fixed gillnets bycatch was limited to 250 kilograms per month. Catches of recreational fishermen from the Northern stock and, for precautionary reasons, from the stock in the Bay of Biscay were restricted by a daily bag limit (Council Regulation (EU) 2017/127).

A.3. Ecosystem aspects

Temperature appears to be a major driver for sea bass production and distribution (Pawson, 1992). Reynolds *et al.* (2003) observed a positive relationship between annual seawater temperature during the development phases of eggs and larvae of sea bass and the timing and (possibly) abundance of post-larval recruitment to nursery areas. Beraud *et al.* (2018) modelled the supply of young of the year in the pelagic phase using individual based models and found higher supply in warm than cold years due to changes in ocean currents driven by wind and effective spawning area. In addition, early growth is related to summer temperature and survival of 0-groups through the first winter is affected by body size (and fat reserves) and water temperature (Lancaster, 1991; Pawson, 1992). Prolonged periods of temperatures below 5–6°C may lead to high levels of mortality in 0-groups in estuaries during cold winters. As a result, any stock recruitment relationships may be obscured by temperature effects (Pawson *et al.*, 2007). Sea bass rectuiment has been shown to be correlated with UK inshore coastal temperatures from January to March (Figure A.3.1, ICES, 2014).

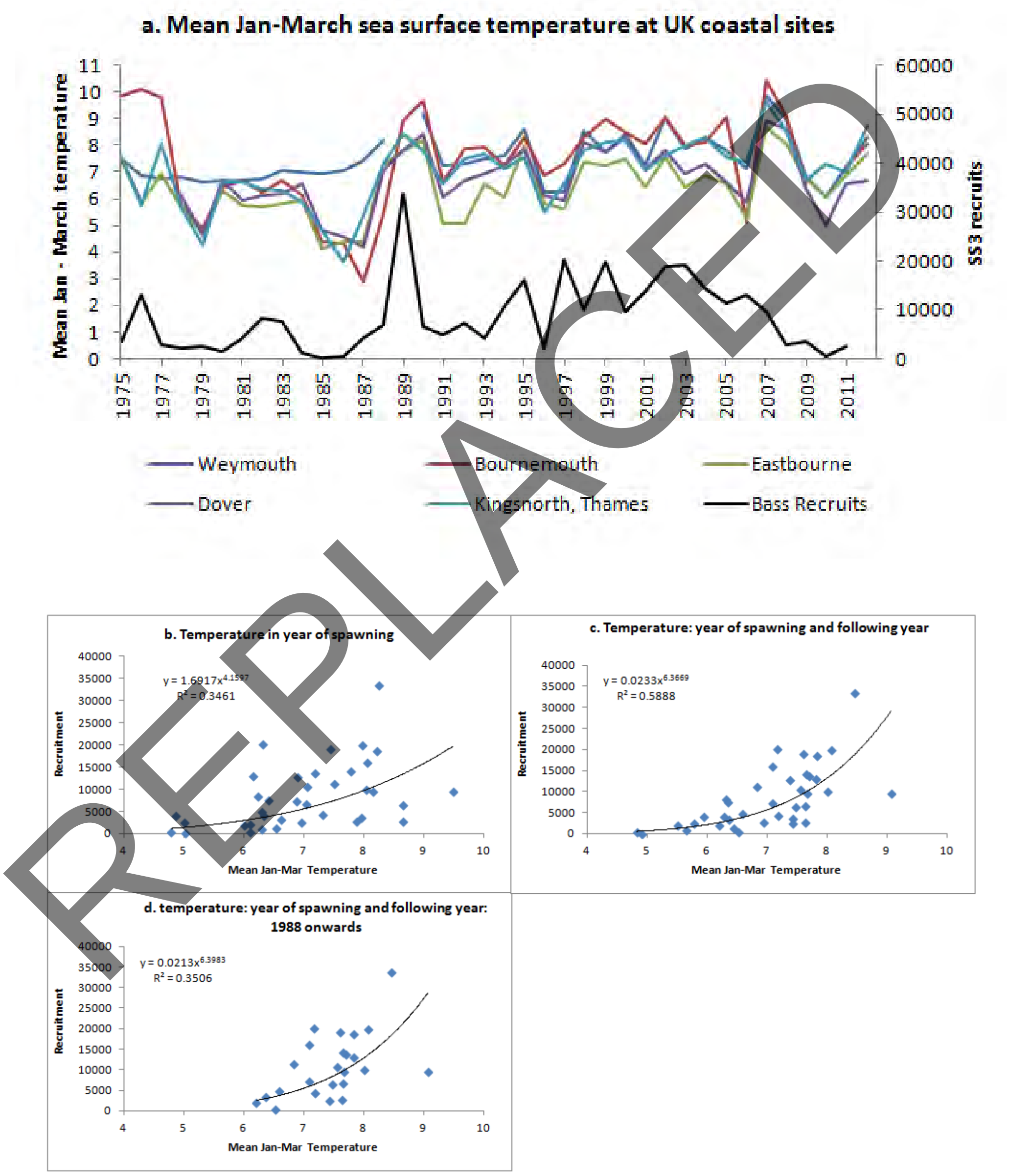


Figure A.3.1. (a) Mean January to March coastal sea temperatures at five sites along the south coast of England, compared with the time-series of sea bass recruitment estimates from the update WGCSE assessment, including pre-1985 values from estimated recruit deviations back to 1975. (b)–(d): correlation between sea bass recruitment and (b) mean temperature for the five sites in the year of spawning; (c) mean temperature in the year of spawning and the following spring; and (d) the same as (c) but restricting the series to 1988 onwards (From ICES, WGCSE 2014).

B. Data

B.1. Commercial catch

B.1.1 Landings data

Landings series for use in the assessment are given in Table B.1.1.1 for the six fleets for which selectivity is modelled: fleet 1- UK bottom trawls and nets; fleet 2- UK lines; fleet 3- UK midwater pair trawls; fleet 4- French combined fleets; fleet 5- other countries plus UK gears not included in fleet 1–3, with selectivity based on fleet 4; and fleet 6- recreational fisheries (2012 is the reference year). The landings figures are from census data (EU logbooks and/or sales slips) from several sources:

1) Official statistics recorded in the ICES official landings database since around the mid-1970s (data from 1985 are used in the assessment) plus preliminary data for 2016.

2) French landings for 2000–2016 from a separate analysis by Ifremer of logbook, auction data and VMS data (SACROIS database, now treated as official statistics from 2010); with earlier official data adjusted as described below.

3) Landings for Belgian vessels supplied directly by the national fisheries laboratory.

4) Landings for Netherlands recorded in ICES database “InterCatch”.

5) UK landings by gear type recorded in official UK landings databases.

Table B.1.1.1. Bass-47: Landings for the country/fleet components included separately in the assessment model.

Year	Fleet 1: UK Trawls, nets	Fleet 2: UK Lines	Fleet 3: UK pelagic trawlers	Fleet 4: France combined gears	Fleet 5: Other countries and gears	Fleet 6: RecFish
1985	70	30	1	870	23	2148
1986	84	33	2	1180	19	1933
1987	96	18	0	1840	25	1753
1988	129	30	8	1028	44	1616
1989	141	29	7	917	67	1490
1990	128	18	22	849	47	1342
1991	152	60	14	971	29	1224
1992	105	23	8	1001	49	1222
1993	146	62	1	979	68	1383
1994	354	154	0	786	76	1640
1995	424	169	4	1057	181	1848
1996	308	128	87	2395	104	1890
1997	335	119	71	1984	111	1819
1998	241	121	85	1773	170	1766
1999	274	148	220	1843	185	1765
2000	236	53	52	1805	261	1816
2001	263	58	97	1883	199	1898
2002	361	75	110	1825	251	1980
2003	353	65	127	2471	443	2035
2004	380	72	131	2604	544	2048
2005	353	59	68	3161	789	2014
2006	359	119	11	3259	629	1955
2007	413	166	37	2771	677	1922
2008	514	163	17	2750	663	1902
2009	486	147	9	2649	598	1859
2010	452	183	42	3236	649	1751
2011	462	143	98	2526	629	1604
2012	564	185	49	2610	579	1440
2013	530	191	39	2871	506	1227
2014	751	236	1	1303	391	1020
2015	440	199	0	1110	317	703
2016*	305	210	2	547	231	212

*** Preliminary.**

Quality of official landings data

The official landings data for sea bass available to WKBASS 2018 are subject to several uncertainties that can affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing (the assessment uses only data from 1985 onwards).
- Reporting of official French data by port rather than fishing ground before 2000. (The best landings estimates are from auctions for this period. During WGCSE, no fishing grounds could be identified for these landings).
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

French landings

From 2000 onwards, Ifremer has provided revised French landings from a separate analysis of logbook and auction data which allocates landings correctly by fishing ground. To generate a consistent series of French landings from 1985 onwards for the area 4 and 7 assessment, IBP-New 2012 adjusted pre-2000 official landings from the ICES database by the average of the Ifremer correction factors by area from 2000–2010:

- 4.b–c and 7.d: 1.04; 7.e and 7.h: 1.6; 7.a and 7.f-g: 0.62.

The accuracy of UK landings statistics improved since the introduction of the Registration of Buyers and Sellers scheme in 2005/2006, particularly for recording of marketed landings of small vessels that do not have to supply EU logbooks. However, the official reported landings of sea bass in the UK are known to underestimate the true total landings, particularly for small-scale inshore fisheries where there has been no requirement to submit EC logbooks. Prior to the introduction of Buyers and Sellers requiring sales documentation, local fishery inspectors estimated landings of the under-10 m fleet using whatever information they had available from auctions, and frequently entered aggregated estimates for multiple vessels into the fishery landings database. Unfortunately the Buyers and Sellers regulations do not cover all landings. The EU Control Regulation allows landings of less than 30 kg to be disposed of for personal consumption without providing sales slips or other documents. This is to reduce the administrative burden for a skipper disposing of small quantities for personal use. However, for small-scale fisheries where there are very large numbers of small vessels often catching small quantities, the cumulative catch of unrecorded small landings can be relatively high. This is likely to be an issue over the full time-series.

UK landings

The UK (England) has previously carried out independent surveys to estimate historical landings data for sea bass, particularly for smaller vessels not supplying EU logbooks. A voluntary logbook scheme was carried out in conjunction with a biennial census of vessels catching sea bass. The census covers different segments of coast in different years (Pickett, 1990). The scheme was stratified by area, gear, and vessel characteristics. Selected vessels from the strata kept logbooks for periods ranging from one to 25 years, and comprised what could be described as a "reference" fleet as opposed to a randomised selection of vessels each year. The scheme was terminated in 2007 and 2008, and reinstated for a further two years (2009 and 2010) before being terminated again. The scheme has now been suspended permanently. The landings tables in some earlier ACOM advice included "unallocated" landings which were the difference between the voluntary logbook estimates and the official UK statistics in each ICES area.

A review of the Cefas logbook scheme in 2012 (Armstrong and Walmsley, 2012a) showed that the previous estimates included recreational charter boats. After removal of these landings, the Cefas logbook estimates for nets and lines still showed substantial differences with official estimates (Figure B.1.1.1). For fixed/driftnets, the landings including the Cefas logbook estimates for under 10 m vessels results in a landings series that is on average around three times higher than the official statistics. For lines, the ratio fluctuates around 3.0 for a large part of the series but was larger from 2000–2005. Insufficient logbooks were available for trawls to allow estimation of fleet-wide landings.

The Armstrong and Walmsley (2012a) review concluded that the survey is sensibly spread over a range of vessel types and gears, but is over-stratified and has insufficient (and declining) coverage of the many survey strata while using *ad hoc*, judgment-based vessel selection schemes rather than randomized selection. Despite the potential biases, the survey results for commercial vessels confirm that the historical official reported landings of sea bass are likely to be underestimates. Neither data source for UK 10 m and under vessels is considered accurate over the historical time-series but WGNEW (ICES, 2008) and IBPBASS (ICES, 2014) found that the stock trends from a statistical assessment model were relatively insensitive to the choice of these two catch histories. The main effect of including the additional landings is to scale biomass estimates up without altering the trend. Total fishing mortality estimates are not affected, as the age profiles of the catches remains more-or-less the same, but the proportion of total F attributable to recreational fisheries in the final stock assessment is reduced slightly by the additional commercial landings. Given the small contribution of UK reported landings of under-10m fleets to total international landings of sea bass, the uncertainties concerning the level of bias in the Cefas logbook estimates, and the lack of such estimates after 2011, the official statistics have been retained in the current assessment. Of more concern would be any change in reporting accuracy over time, as this would lead to biased assessment trends using reported landings figures.

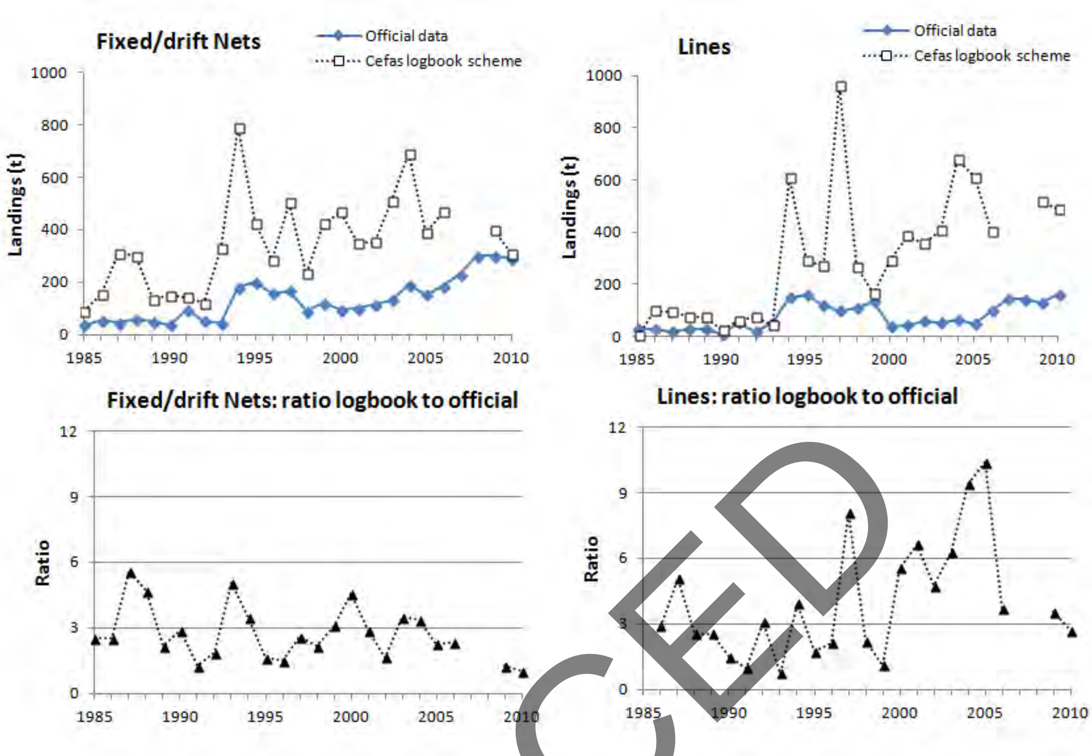


Figure B.1.1.1. Top: estimates of sea bass landings for under-10 m UK netters and liners based on the Cefas logbook and port survey scheme. Bottom: ratio of landings of these gears including the Cefas logbook estimates for <10 m commercial vessels, and the total official reported landings of all UK vessels using these gears.

Dutch landings

Landings and effort data from the commercial fleet are available from the EU logbooks; market category composition of landings is available from the auction data (sale slips); and size and age data are available through market sampling. The fisheries were described in detail in van der Hammen *et al.* (2013).

EU logbook data

Official EU logbook data of the entire Dutch fleet are maintained by the NVWA (formerly known as the General Inspection Service, AID). IMARES has access to these logbooks and stores the data in a database (VISSTAT). EU logbook data contain information on:

- Landings (kg): by vessel, trip, ICES statistical rectangle and species.
- Effort (days absent from port): by vessel, trip and ICES statistical rectangle.
- Vessel information: length, engine power and gear used.

Logbook data are available from the entire Dutch fishing fleet and from foreign vessels landing their catches in the Netherlands.

Auction data: landings by market category

Auction data cover both the total Dutch fishing fleet and foreign vessels landing their catches on Dutch auctions. These data are also stored in VISSTAT and contain information on landings by market category (kg): by vessel, trip (landing date), and species.

Further information on availability and quality of landings data by country is provided by IBPBASS 2014.

B.1.2. Discards estimates

UK data

Survey design and analysis

Estimation of sea bass discards is problematic because the observer scheme covers all vessel trips in a stratum without reference to target species, and overall it samples less than 1% of all fishing trips. As sea bass are absent or at very small numbers in a large fraction of fishing trips throughout the year, particularly in winter, the amount of sample data on sea bass is very low, so the estimates are likely to have poor precision and variable biases related to inclusion of under 10 m vessels. Vessels under 10 m, that are responsible for a large fraction of sea bass catches, were excluded until recent years on health and safety and other logistical grounds, and although under 10 m vessels have been included since 2007, the fleet of vessels under 7 m remain excluded.

Raising of UK discards data to the fleet level is currently performed using a ratio estimator of reported landings in a stratum to the computed retained weight of sea bass in sampled trips. This assumes that the retention curve for sampled vessels is representative of all vessels in the stratum.

Data coverage and quality

UK discards data are available for métiers associated with trawls and fixed/driftnets only. Discards from commercial line boats are expected to be relatively low and have high survival, so this fleet sector is excluded from the scheme for sea bass. As sampling is targeted at all species, annual coverage of the sea bass fisheries is relatively limited.

Numerically, the largest numbers of sea bass discarded from UK fisheries are from the bottom-trawl fleet, with much smaller numbers from nets and even less from beam trawls. Only eleven midwater pair trawl trips were observed up to 2013, and discarding of sea bass was negligible as the fishery targets mainly adults. No sea bass discards were observed in the eight longline trips observed. The raised length frequencies of discarded and retained sea bass, aggregated overall years, are available along with the retention ogives. Discards estimates for 2016 suggest increased discarding following the increase in MCRS from 36 cm to 42 cm part way through 2015 (ICES, 2017).

Sampling levels for UK and French discard sampling, and discards estimates, are given in the WGCSE report and updated annually.

French data

Survey design and analysis

The French sampling schemes utilise vessel-list sampling frames and random selection of vessels within strata defined by area and fleet sector. From the activity calendars of French vessels for the previous year, vessels are grouped by the métiers practised. Thus, a vessel may belong to multiple groups if practicing several métiers in the period. If the métier has to be sampled as priority one, the vessel to be boarded is chosen randomly within this group of vessels. The observer then chooses to go on board for a trip. During the trip, the fishing operations corresponding to métier number one are sampled. Optionally, if the vessel practises several métiers during the trip, fishing operation of the métier number two will also be sampled if the métier is included in the annual sampling plan. If the métier is not part of the plan, at least one fishing operation of this métier must be sampled during the the trip. (complete document on sampling protocol in written in French :http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf)

Data coverage and quality

Discards data are only available for French fleets since 2009. Results for 2012 are in the annual French reports (http://archimer.ifremer.fr/doc/00167/27787/25978.pdf). Discards estimates for France are from vessel selections that, for some areas and gears, include relatively limited numbers of observed trips where sea bass are caught and discarded. Precision is therefore very low at current sampling rates. In France the low sampling rate observed can be explained by the low discarding rate.

Spain

No sea bass discards were observed or reported for any métier in the 2003–2013 period. Number of sampled hauls per métier and area were presented to IBP-NEW 2012 (ICES, 2012a).

Discards data from other European countries

Discards data for Dutch beam trawlers were presented to IBP-NEW 2012 (ICES, 2012a), as annual mean numbers discarded per hour in 2004–2010. No commercial fisheries for sea bass exist in Ireland.

B.1.3. Recreational catches

Recreational marine fishery surveys covering different parts of the sea bass stock in the North Sea, Channel, Celtic Sea and Irish Sea have been developed in France, Netherlands, England and Belgium (ICES, 2012c). Survey design and methods of recreational catch estimation are described in WKBASS 2018 (ICES, 2017b; 2018).

Data from France

A survey of recreational fishers, focusing mainly on sea bass, was conducted between 2009 and 2011. Estimates of sea bass recreational catches were obtained from a panel of 121 recreational fishermen recruited during a random digit dialling screening survey of 15 000 households in the targeted districts. The estimated recreational catch of sea bass in the Bay of Biscay and in the Channel was 3170 t of which 2350 t was kept and 830 t released. The estimates for subareas 4 and 7 were 940 t kept and 332 t released.

The precision of the combined Biscay and Channel estimate was relatively low (CV=26%; note that the figure of 51% given in IBPNEW 2012 was incorrect). This gives an average and 95% confidence intervals of 3170 t [1554 t; 4786 t] for the whole subareas 4, 7 and 8. Increasing the panel from 121 to 210 fishermen would be expected to improve precision to 20% and increasing this panel to 500 would improve precision to 13%.

The main gears used, in order of total catch, were fishing rod with artificial lure, fishing rod with bait, handline, longline, net and spear fishing. Approximately 80% of the recreational catch was taken by sea angling (rod and line or handline).

A new survey was conducted from July 2011 to December 2012, based on a similar methodology to the previous study (not only on sea bass this time, but also on other marine species including crustaceans and cephalopods). A random digit dialling screening survey of 16 130 households led to the recruitment of a panel of 183 fishermen to keep logbooks. In parallel, 151 fishermen were recruited on site by the Promopeche association, and 30 more via the sea bass fishermen panel set up in 2009. This resulted in 364 panel members keeping logbooks describing their catches (species, weight, size, etc.) The focus of the survey on sea bass shows that in Atlantic (Bay of Biscay and Channel), the estimated recreational catch of sea bass in 2012 was 3922 t of which 3146 t was kept and 776 t released. At this time results have to be considered as provisional, (results split between Bay and Biscay and Channel are not available yet with relative standard error).

UK (E&W)

The survey programme *Sea Angling 2012*, based on a statistically sound survey design started in 2012 to estimate fishing effort, catches (kept and released) and fish sizes for shore based and boat angling in England. The survey does not cover other forms of recreational fishing. Results are available in Armstrong *et al.*, 2013.

The surveys adopted, where possible, statistically sound, probability based survey designs, building on knowledge gained through participation in the ICES Working Group on Recreational Fishery Surveys (ICES, WGRFS 2012c; 2013b). Two survey approaches were adopted: first a stratified random survey of charter boats from a list frame covering ports in England, and second an on-site stratified random survey of shore anglers and private boat anglers to estimate mean catch per day, combined with annual effort estimates derived from questions added to a monthly Office of National Statistics household survey covering Great Britain.

A list of almost 400 charter boats was compiled for the charter boat survey, and 166 skippers agreed to participate. Each month over a twelve month period in 2012 and 2013, 34 randomly selected skippers completed a diary documenting their activities, catches and sizes of fish. A diary was completed whether or not any fishing took place. Data from 5300 anglers were collected. Total annual catches were estimated by raising the monthly catches per vessel from the diaries to all vessel-month combinations in the frame, and raising this to all vessels including refusals. The estimated total annual catch of sea bass for the entire coast of England was 44 t (RSE 31%) of which 31 t was kept. The release rate by number was 37%. The charter boat survey has potential bias due to the large non-response rate, if non-respondents have different catch rates to respondents.

The Office of National Statistics (ONS) household survey covered 12 000 households during 2012, and from this it was estimated that 2.2% of adults over 16 years old went sea angling at least once in the previous year. The surveys estimated there are 884 000 sea anglers in England. Estimation of fishing effort by shore and private boat anglers proved very difficult due to the overall small number of households with sea anglers in the survey. A range of methods was explored to estimate annual and seasonal effort using the ONS data alone, and combining it with observations from on-site and online surveys. It has not been possible yet to agree on a best estimate of effort, and for that reason the estimates of total catch (cpue × effort) for shore and private boat angling are given as a range of plausible values.

The survey of anglers fishing from the shore and private boats to estimate cpue was carried out throughout 2012 using on-site interviews. A stratified random design was adopted to select shore sites and boat landing sites on a weekly basis from site lists stratified into low-activity and high-activity sites. The shore survey used roving-creel methods (collecting data from partial angling trips), and the private boat survey a roving access-point survey (data from completed trips). Visits were made to 1475 shore sites and 425 private boat sites, and 2440 anglers were interviewed. The mean daily catch rate of kept and released fish of each species was estimated based on the survey design, and sizes of caught fish were recorded. Cpue for shore angling was estimated using catches for the observed trip duration and estimates of expected total trip duration for that day. A length-of-stay bias correction was applied based on expected total trip duration. The catch-per-day estimates were combined with estimates of total annual fishing effort (days fished) obtained from the ONS survey to estimate total annual catches. Release rates, by number, were 82% for shore angling and 57% for private boats. Non-response rates were very low (<10%) in this survey. The range of point estimates for shore-caught sea bass was 98–143 t (total) and 38–56 t (kept), and for private and rented boats was 194–546 t (total) and 142–367 t (kept). The relative standard errors for the individual shore and private boat estimates were relatively high at 40–50%.

Combining the catch estimates for charter boats, private boats and shore angling, the point estimates of annual kept weights of sea bass ranged from 230–440 t (Table 2.4.1c), compared with total UK commercial landings of almost 900 t in 2012. The combined estimates of sea bass catches had precision (relative standard error) estimates of 26%–38%for the different effort estimation methods. The relatively large standard errors combined with the range of plausible methods of estimating effort for shore and private boats.

A new UK survey in 2016 used a different survey approach to the surveys in 2012 and is still being evaluated to determine if the 2012 and 2016 survey estimates are compatible given the very different results obtained.

Netherlands

Sea bass are taken by recreational sea anglers in the Netherlands. A recent survey investigated the amount of sea bass caught by recreational fishers (van der Hammen and de Graaf, 2012; 2015; ICES, 2012c) from March 2010 to February 2011 and from March 2013 to February 2013. Estimates of recreational sea bass were obtained from a panel of 1043 recreational fishermen (in the first survey) recruited during a telephone survey of 109 293 people. Revised estimates were provided to WGCSE 2013 (ICES, 2013a). The catch weights are estimated with a limited amount of length–frequency data, and are therefore less reliable than the estimates in numbers (and may also be adjusted if more data are available). For the same reason, there are no 'returned' estimates by weight (yet).

The estimated total recreational catch of sea bass was 366 000 fish (RSE 30%), of which 234 000 were retained, equivalent to 138 t. These results are mainly applicable to Subarea 4.

Belgium

A recreational fishing survey was conducted in 2013 in Belgium by the Belgian Fisheries Institute, using a questionnaire approach, in order to meet DCF requirements. The estimated retained catch of sea bass was 60 t.

Hooking mortality rates

The US National Marine Fisheries Service has in the past used an average hooking mortality of 9% for striped bass, estimated by Diodati and Richards (1996). Striped bass are very similar to European sea bass in terms of morphology, habitats and angling methods. A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.) The mean hooking mortality rate was 0.19 (standard deviation 0.19). Direct experiments are needed on European sea bass to estimate hooking mortality for conditions and angling methods typical of European fisheries.

Total recreational catch

Total catches are given in the WGCSE reports and updated when new estimates become available. They are also documented in the annual reports of the ICES Working Group on recreational fisheries (WGRFS).

WKBASS2 2018 considered and reworked the available estimates of removals for 2012 from IBP-BASS2 (ICES, 2016a) and WGCSE (2016b) , as the sum of retained fish and released fish with PRM of 5% applied (Lewin *et al.*, 2018), with Belgium estimates removed. The assumption of constant recreational F from 2015 onwards was not longer appropriated due to the introduction of management restrictions which have likely reduced recreational F. A Working Document presented by Hyder *et al.*, 2018 (ICES, 2018) calculate the reduction in retained catch that would be expected in 2015, 2016, 2017 in response to management measures.

B.2. Biological sampling

B. 2.1 Length and age compositions of landed and discarded fish in commercial fisheries

Length and age compositions of sea bass landings were available to WKBASS 2018 from sampling in the UK and France.

UK

Sampling methods and analysis

The UK (England and Wales) sampling programme for length compositions of sea bass covers sampling at sea and onshore. The sampling design for at-sea sampling is described above. The onshore sampling programme uses an area list frame comprising port days, currently stratified by quarter, ICES Division and an index of “port size”. “Large” ports are sampled more intensively than “small ports”. Separate list frames of ports are established for pelagic trawlers, beam trawlers and demersal trawl, nets, and lines. Sampling targets are set to achieve a specified number of port visits by stratum, taking account the need for fleet based as well as stock based data specified by the EU Data Collection Framework, although other diagnostics are monitored such as numbers of fish measures and otoliths/scales collected by species. This scheme has been in development and operation since around 2010, when Cefas took over the sampling from the Marine and Fisheries Agency. Prior to that, the sampling targets were mainly set as numbers of fish of each species to measure or age by quarter, district, and gear groupings, with minimum numbers of sampling trips also specified to spread the sampling out.

Length compositions are first vessel-raised using ratios of landed live weight to predicted live weight of the length frequency calculated from a length–weight relationship:

$$W\ (kg) = 0.00001296\ (L+0.5)^{2.969}$$

Raised LFDs are then summed over vessels within a sampling stratum and raised to give total raised fleet LFDs per stratum, which are then combined. This procedure ensures sums-of-products ratios of 1.0, but will lead to some bias in numbers-at-length due to discrepancies between true fish weights and calculated fish weights from the length–weight relationship.

Data coverage and quality

Age compositions for UK commercial fishery landings of sea bass are derived from biennial (January–June and July–December) age–length keys (ALK) constructed for four areas: 4.b-c; 7.de; 7.ah; 7.f–g. These are applied to fleet-raised landings length frequencies for each of four gear groups (bottom trawls; midwater trawls; fixed/driftnets and lines) in each area. Further details are given in the ICES IBP-NEW 2012 and WGCSE 2013 reports and in the stock annex along with tables giving numbers of trips sampled for length and age and numbers of fish measured and aged.

A recommendation of WGCSE 2013 was to expand the UK age frequencies to the full recorded age range and to re-evaluate the plus group definition (previously at 12+). Sea bass have been recorded to almost 30 years of age, and it was thought that having more true ages in the Stock Synthesis input data could allow better estimates of early recruit deviations. The necessary extractions were done for IBPBass, and the data were examined in detail by Armstrong and Readdy (IBP-BASS 2014 Working Document_01). Bubble plots and catch curves showed that coherent information on year classes was present well beyond the last true age (11) previously adopted. The exploratory SS3 runs show that the different choices of plus group (12+; 16+; 18+; 20+) have relatively little impact on the results, other than a slightly better estimation of early recruit deviations. Expanding the age compositions helps the fit of domed selection curves for fleets where this is appropriate, but risks an increasing number of zero catch entries for older ages as recent weak year classes feed into future catches and become depleted. A plus-gp of 16+ was recommended for further model development and agreed by IBP-BASS 2014. Sampling of midwater trawls prior to 1996, and in 1997, was considered too poor to develop age compositions. All datasets show a very strong 1989 year class and very weak 1985–1987 year classes.

France

Sampling methods and analysis

The French sampling programme for length compositions of sea bass covers sampling at-sea and onshore. Since 2009, both sampling types are first based on métiers composition and their relative importance per fishing harbours and month. Both are also designed to sample the whole catch following a concurrent sampling of species, potentially leading to low sea bass sample size. In order to complement this effort, specific sampling for sea bass at the market is added at times and harbours when higher landings are occurring, especially from métiers targeting sea bass. The sampling frame is based on the main harbours, gear types (or grouping of métiers) and month and is available to all samplers on a dedicated website. Real-time follow-up of the plan, refusal rates and their reasons, time taken to sample, all this information is also available from the website, together with sampling protocol (in French: http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf).

Before 2009, only market specific sampling was in place, and the sampling plan was designed and followed by the stock coordinator. The French sampling programme for age compositions of sea bass is based on age–length keys with fixed allocation. For the

7.e and 7.h area, quarterly French landings at auctions are sampled in order to collect five scales (from 2000 to 2008) or three scales (from 2009) by length class (cm). The information is available from 2010 for area 8ab, but not for other areas. All length samples are stored in a central database (Harmonie) and regular extracts are available in the COST format. Raising the data to the population is done using COST tools and a special forum for discussing the outcomes of the analysis is held each March to prepare the datasets for the assessment working groups.

Data coverage and quality

Length compositions of French sea bass commercial landings are constructed from 2014 for the area including 4.b–c, 7.de, 7.ah, and 7.f–g, for all métiers. The input data for French fleets in Stock Synthesis are the fleet aggregated length compositions in 2 cm classes (20–21.9, 22–23.9, etc.) for each year from 2000 onwards.

The statistical design of fishery sampling schemes has undergone change in recent years in the UK and France, following recommendations from ICES workshops on sampling survey design, with a move towards more representative sampling across trips within fleet segments. This can result in sampling more trips that have small catches of sea bass, and is one reason for the increase in numbers of sampled trips with sea bass since 2009 in France which does not imply an increase of the proportion in numbers of fish measured per trip.

Other countries

Fishery landings length or age compositions from other countries catching sea bass were not available to IBP-BASS 2014. The Netherlands did collect age samples of sea bass every year from 2005 to 2008. From 2010 onwards, age samples are collected only once every three year. In the IMARES market sampling, data on length, age, sex, and weight are collected for several commercially important species. For sea bass this is done on an irregular basis and data are only available for some years, with market sampling done since 2005. The age sampling frequency is now triennial (2010, 2013, etc.) Every three years four samples of 15 fish (60 fish in total) are aged, and every year the lengths of 24 samples of 15 fish (360 fish in total) are taken. Otoliths and scales that are retrieved from the fish are sent to Cefas for age reading. Length samples are collected every year. All samples are collected in the auctions in the south of the Netherlands, where most sea bass are landed. The quality of the data is good enough to be used in assessments, but both the length and age data need processing before use.

Effective sample sizes for length and age compositions

The effective sample size for annual estimates of length or age composition are between the number of trips sampled and the number of fish measured or aged, due to cluster sampling effects. Effective sample sizes have not been computed for UK and French sampling data for sea bass. In the meantime, effective sample sizes for all the fleets with the exception of the "*Others*" fleet are set to the number of trips sampled for length in each of the years. The effective sample sizes for the age frequency distributions for the combined UK trawls and nets and lines are set to the number of trips sampled for age. For the UK midwater trawl and the French combined-fleet the effective sample size for each year is set to 50 and 100 respectively.

Accuracy and validation of age estimates

Age-reading consistency

Consistency in age reading of sea bass between four operators in Cefas and Ifremer was examined during a limited exchange of otolith and scale images between laboratories in 2011, organised by the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (Mahé *et al*., 2012). A total of 155 fish of 17–74 cm was sampled on board French research vessels during two international surveys. The precision of ageing was similar for scales and otoliths. The coefficient of variation of age readings for individual fish was around 12% implying a standard deviation of +/-1 year for a nine year-old fish, with relatively few fish having identical readings by all four operators. However it was noted by the operators that photographic images were more difficult to evaluate than original age material, which was likely to have a negative effect on the consistency of ageing. These results provided no indication of the validity of ages, only the consistency between operators, and cannot indicate data quality in earlier years when different operators provided the age data.

Age validation

IBP-BASS 2014 were not aware of specific studies to validate absolute ages of sea bass derived from otolith or scale readings. Strong and weak year classes can be followed clearly to over 20 years of age in UK data, although it is not known to what extent the elevated numbers of sampled fish in immediately adjacent year classes is a true reflection of year-class strength or a consequence of age errors discussed in the previous section. Year-class tracking is less clear in the younger ages 3–5 although this will be affected by gear selectivity and changes in fish behaviour.

Sea bass show relatively broad length-at-age distributions, and it has been noted in French data (Laurec *et al*., 2012 WD to IBP-NEW 2012) that the length-at-age distributions can have unusual patterns including some multiple modes that could indicate age errors. This will result in some smoothing of age data across neighbouring year classes. In the UK data, unusual patterns in length-at-age distributions for some younger ages appear related more to effects of minimum landing size on data from the fishery.

Inclusion of age error parameters in Stock Synthesis model

CVs for ageing error by age class can be included in Stock Synthesis. Based on the ICES sea bass scale exchange in 2002, the CVs of ~12% can be specified as increasing values per age class to give a standard error of ~1 year per age class. These are used in the SS3 observation submodel to derive expected values for observed data on age distributions.

B.2.2. Growth parameters

Pickett and Pawson (1994) provide plots of growth curves for female and male sea bass based on samples collected in the 1980s in areas 4 and 7. The samples used by Pickett and Pawson (1994) for growth and maturity analysis were obtained from a range of fishery and other sources.

A re-analysis of UK historical age–length data including more recent samples was conducted in 2012, using data for the full UK sampling series from 1985 to 2010 (Armstrong and Walmsley, 2012b). The data are derived from sampling of UK fishery catches around England and Wales as well as from trawls surveys of young sea bass in the

Solent and Thames estuary. More than 90 000 sea bass have been aged since 1985. The inshore surveys are mainly young sea bass up to 3–5 years of age, whereas the fishery samples include fish up to 28 years of age.

All ageing is done from scales, excluding scales considered to be re-grown. On surveys, scales are collected in a length-stratified manner from individual hauls with a view to building age–length keys. A similar approach has historically been adopted for catch sampling. This may lead to non-random sampling of individual age groups when the catch numbers are well in excess of numbers sampled from an individual catch. It will also lead to some overestimation of the standard deviation of lengths-at-age.

All ages for fitting growth curves are referred to a nominal January 1 birthdate, according to month of capture. Parameters of the von Bertalanffy growth curve were fitted in Excel Solver using non-linear minimisation of ∑(obs-exp)^2 for lengths-at-age of individual fish, by area and for all data combined.

Von Bertalanffy model parameters were as follows:

Area	4.b–c	7.d	7.e	7.a, 7.f–g	All areas
Linf (cm)	82.98	87.22	92.27	81.87	84.55
K	0.1104	0.09298	0.07697	0.09246	0.09699
t_0 (years)	-0.608	-0.592	-1.693	-1.066	-0.730

Standard deviation of length-at-age distributions increases linearly with age according to:

SD (age) = 0.1166*age + 3.5609

The sampled sea bass show some sexual dimorphism of growth from about seven years of age onwards. It is currently not possible to implement a sex-disaggregated Stock Synthesis assessment, therefore a combined-sex growth curve is adopted. Mean length-at-age has not shown any trend over time, and length-at-age is also very similar in strong and weak year classes (Armstrong and Walmsley, 2012b). Hence data have been combined over the full series to estimate growth parameters.

B.2.3. Maturity

Spawning grounds and season

Ripe adult sea bass have been caught by pelagic trawling in the south of Division 8.a and in the north of Division 8.b in the Bay of Biscay during January–March (Morizur, unpublished data), and planktonic egg surveys (Thompson and Harrop, 1987; Jennings and Pawson, 1992) have shown that sea bass spawn offshore in the English Channel and eastern Celtic Sea from February to May. Spawning started in the Midwestern Channel when the temperature range associated with sea bass egg distributions was 8.5–11°C, and appeared to spread east through the Channel as the surface water temperature exceeded 9°C. Seasonal patterns of occurrence of advanced maturity stages in UK samples also indicate spawning mainly January to May in ICES areas 4 and 7 (Armstrong and Walmsley, 2012c). Spawning and ripe sea bass are also found in the southern North Sea (information from commercial fisheries and angler reports in Netherlands supplied to IBP-NEW 2012 by F. Quirijns).

Previous estimates of maturity at length/age, and data available for re-analysis

SGBASS 2004 reported that around Britain and Ireland, male sea bass mature at a length of 31–35 cm, aged 4–7 years, and females at 40–45 cm, aged 5–8 years, (Kennedy and Fitzmaurice, 1972; Pawson and Pickett, 1996), and data from the southern part of the Bay of Biscay (Lam Hoai, 1970; Stequert, 1972) indicate that male matures at a length of 35 cm (age 4) and females at 42 cm (age 6). Data provided by Masski (1998) from samples taken from 7.e bottom trawlers (41 females) indicate that 40% and 82% of females were mature at-age 6 and 7 respectively, with a very small percentage mature at-age 5.

Collection of maturity data is difficult as few adult sea bass are caught in surveys that are typically landed whole and are extremely expensive to purchase. Samples collected by the UK (Cefas) during 1982–2003 and 2009 in ICES areas 4 and 7 were re-analysed for IBP-NEW 2012 (Armstrong and Walmsley, 2012c). Samples have come from all around the coast of England and Wales, though few fish were from the Irish Sea (7.a).

Defining a maturity marker for sea bass

Sea bass are multiple batch spawners, as indicated by size distributions of oocytes (eggs) in ovaries (Mayer *et al*., 1990). This means that the ovary will start to mature oocytes through to vitellogenic stages during the months immediately prior to the spawning season. Historical maturity staging of sea bass by the UK has used the maturity key given in Pawson and Pickett (1996; Table B.2.3.1). In their analyses, they treated stage 2 as mature, and stage 3 as immature. Their reasoning was that stage 3 ovaries (early maturing) were found in smaller sea bass than later stages (4+) indicating that many of these fish may not proceed to spawning. Sea bass migrate offshore to spawning grounds, and it is likely that early maturing fish could be over-represented, and advanced maturing fish underrepresented in inshore catches sampled during the period of spawning migrations. An additional spent stage (VIII) has been occasionally recorded.

The identification of a suitable marker to identify maturity has to take into account the probability of finding a fish at any maturity stage in different months, the duration of a stage, and the availability/catchability of fish at that stage of maturity. When the majority of mature sea bass have entered the batch spawning cycle in spring, all stages represented in batch spawning (III to VII) will be evident and should be distinct from immature fish. Therefore, providing that fish in all stages are equally catchable, the best markers for maturity are the maturity stages representing different stages in the batch spawning cycle, sampled at a time when spawning is taking place (or immediately before). This is the conclusion of recent ICES workshops on maturity staging of gadoids and flatfish, which recommends sampling within a month or so of the beginning and end of the spawning season. Experience with other roundfish and flatfish stocks is that it can be very difficult to distinguish between virgin females and fish that have spawned previously, when sampled in the non-spawning period. The UK data were therefore re-analysed using samples from December to April, treating all fish of maturity stages 3 to 7 as mature.

Re-estimation of maturity ogives from UK data

Maturity was modelled using a binomial error structure and logit link function, fitted in R to individual observations. The logistic model describing proportion mature by 1 cm length class *L* was formulated as:

$$\mathrm{Pmat}(L) = 1/(1+e^{-(a+bL)})$$

defined by the parameters slope *b* and length intercept *a*. These parameters were estimated separately for females and males.This can also be expressed as:

$$Pmat(L) = 1/(1+e^{-b(L+c)}) \text{ where } c = a/b$$

Stock Synthesis uses the second formulation, and the parameters required are the slope (b = 0.3335: entered as a negative value) and the length inflection, which is the estimated length at 50% maturity (L_{50} = 40.65 cm).

The 2009 data came from a large sample of sea bass taken in spring from a few trips specifically to revisit sea bass maturity, but this sample dominates the time-series of sampling which is spread over very many more trips and months than in 2009 and therefore has better coverage. Maturity ogives were fitted including and excluding 2009 data. The inclusion of 2009 data, which were for a relatively restricted length range of fish around 40 cm, has the effect of improving the fit of the model near the top of the ascending limb of the maturity ogive for females (Figure B.2.3.1). However the very high weighting for these lengths compared to the data for lengths <35 cm results in the model fitting very poorly to the smaller length classes. Excluding the 2009 data allow the length classes <35 cm to carry more weight, and the ogive appears to fit the data for 30–40 cm sea bass more closely, although the fit for lengths >40 cm is poorer. Addition of the 2009 data effectively shifts the L_{50} from around 41 cm to 35 cm. In contrast, inclusion or exclusion of the 2009 data has less effect on the model fit for males (Figure B.2.3.1). On balance, it was considered undesirable for a few large hauls in a recent year to have excessive leverage in the model fit, and the model excluding 2009 was considered preferable as a long-term maturity ogive for use in assessments.

Table B.2.3.1. Macroscopic characteristics of the maturity stages of the gonads of sea bass. (Pawson and Pickett, 1996)

Maturity stage		Ovary	Testis
I	Immature	Small thread-like ovary, reddish-pink	Small, colourless, thread-like; testis not practical to differentiate macroscopically <TL 20 cm
II	Recovering spent	Ovaries one-third length of ventral cavity, opaque, pink with thickened walls and may have atretic eggs	Testis one-third length of ventral cavity, often bloodshot with parts dark grey
III	Developing (early)	Ovaries up to one-half length of ventral cavity, orange-red, slight granular appearance, thin, translucent walls	Testes thickness 10–20% of length, dirty white, tinged grey or pink
IV	Developing (late)	Ovaries greater than one-third length of ventral cavity, orange-red; eggs clearly visible, but none hyaline	Testes flat-oval in cross section and thickness >20% of length, half to two-thirds of ventral cavity. White colour and milt expressed from vent if pressure applied to abdomen
V	Gravid (ripe)	Swollen ovaries two-thirds length of ventral cavity, pale yellow-orange; opaque eggs clearly visible with some hyaline	Testes bright white and more rounded-oval in cross section. Only light pressure required to cause milt to flow from vent
VI	Running	Ovaries very swollen; both opaque and larger hyaline eggs clearly visible beneath thin almost transparent ovary wall, and expressed freely with light pressure	Testes becoming grey-white and less turgid. Milt extruded spontaneously
VII	Spent	Ovary flaccid but not empty, deep red; very thick ovary wall; dense yellow atretic eggs may be visible	Testes flattened and grey, flushed with red or pink, larger than those at stage II or III

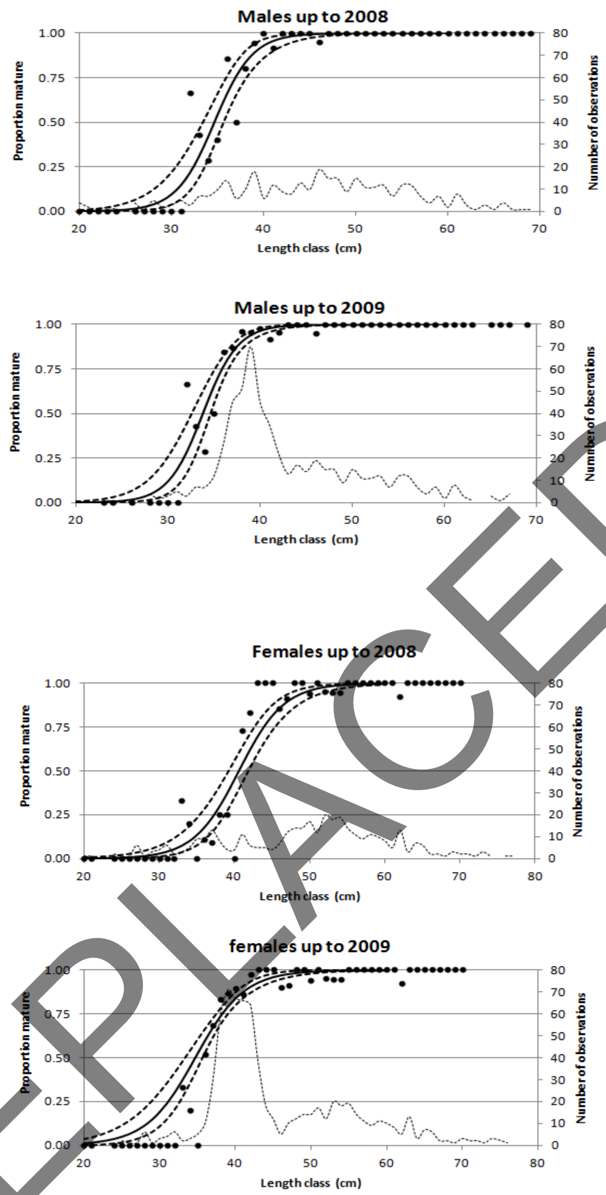


Figure B.2.3.1. Logistic maturity ogives (with 95% confidence intervals) fitted to individual maturity records for sea bass during December–April. Top plot: excluding 2009 data (top); bottom plot: including 2009 data. Points are proportion mature in the raw data. Dotted line is the number of observations per length class.

The parameters of the model $Pmat(L) = 1/(1+e^{-b(L+c)})$ are given below:

	Females	Males
Intercept (a)	-13.556	-16.851
Slope (b)	0.33349	0.4861
c = a/b	-40.649	-34.6652
L_{25}	37.35	32.41
L_{50}	40.65	34.67
L_{75}	43.95	36.93

The logistic model for females and males is:

Pmat(L) = 1/(1+e-0.33349(L-40.649)) (females)
Pmat(L) = 1/(1+e-0.4861(L-34.6652)) (males)

The maturation range for females occurs at ages 4–7, and at ages 3–6 for males, as shown by the proportion mature at-age in the same samples used for estimation of length-based maturity ogives (Table B.2.3.2).

Table B.2.3.2. Raw proportion mature at-age in 1982–2003 UK samples from all areas.

	Females	Males
age 2	0.00	0.00
age 3	0.00	0.27
age 4	0.17	0.54
age 5	0.21	0.61
age 6	0.55	0.91
age 7	0.95	0.98
age 8	1.00	1.00
age 9	0.95	0.98
age 10+	1.00	1.00

Data on sea bass maturity have also been collected in the Netherlands since 2005. Methods and data are described by Quirijns and Bierman (2012). For male fish, too few specimens were measured to estimate maturity. Maturity-at-age and length are plotted in Figure B.2.3.2. Note that only few fish were measured in the lowest age and length groups. At age 4, 50% of the females are mature. This is substantially lower than the age at 50% maturity in the Cefas 1982–2003 samples (Table B.2.3.2), and closer to the ogive from Cefas data including the large 2009 sample (Figure B.2.3.1), for which L_{50} was around 35 cm (~4 years old). This may confirm that sea bass could now be maturing earlier than in the 1980s–2000s, at least for the North Sea. The plot showing maturity-at-length for Netherlands samples is not based on enough measurements to show a reliable maturity ogive.

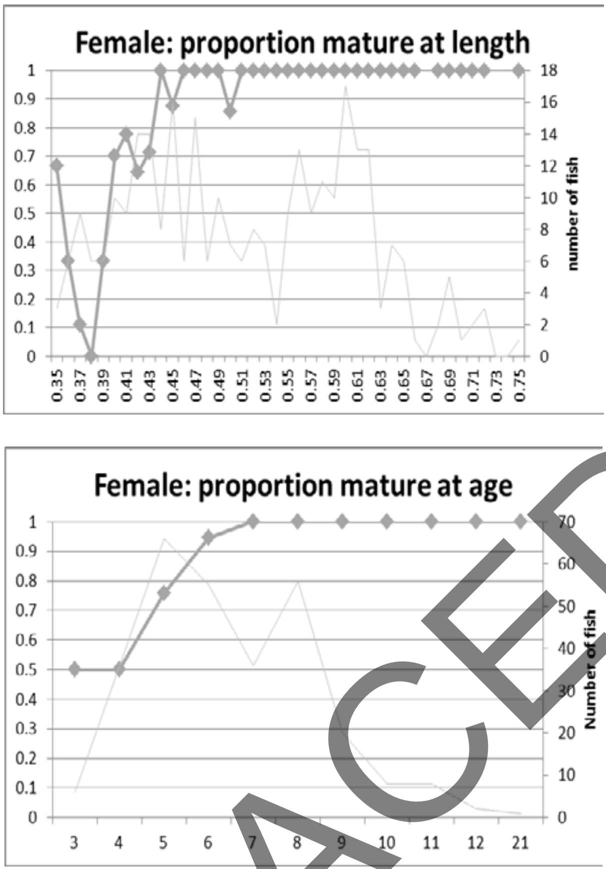


Figure B2-2. Proportion of mature at-age and length (length in m) for female sea bass sampled in the southern North Sea by the Netherlands during 2005 (thick line). The thin line shows the number of fish measured on which the proportion of maturity is based.

B.2.4. Larval dispersal, nursery grounds and recruitment

Sea bass larvae resulting from offshore spawning move steadily inshore towards the coast as they grow and, when they reach a specific developmental stage at around 11–15 mm in length (at 30–50 days old), it is thought that they respond to an environmental cue and actively swim into estuarine nursery habitats (Jennings and Pawson, 1992). From June onwards, 0-group sea bass in excess of 15 mm long are found almost exclusively in creeks, estuaries, backwaters, and shallow bays all along the southeast, south, and west coasts of England and Wales, where they remain through their first and second years, after which they migrate to overwintering areas in deeper water, returning to the larger estuaries in summer. Several studies indicate the existence of similar sea bass nursery areas in bays and estuaries on the French coasts of the Channel and Bay of Biscay and southern Ireland. During winter, juvenile sea bass move into deeper channels or into open water, and return in spring to the larger estuaries and shallow bays on the open coast, where they remain for the next 2–3 years.

On the south and west coasts of the UK, juvenile sea bass emigrate from these nursery areas at around 36 cm TL (age 3–6 years, depending on growth rate), often dispersing well outside the 'home' range, and not necessarily recruiting to their specific parent spawning stock (Pawson *et al.*, 1987; Pickett and Pawson, 2004). It appears that there is substantial mixing of sea bass at this stage throughout large parts of the populations' distribution range. When they reach four or five years of age their movements become more wide-ranging and they eventually adopt the adult feeding/spawning migration patterns (Pickett and Pawson, 1994).

Sea temperature has a strong influence on sea bass dynamics, affecting larval dispersal, spatial distributions, and also the growth and survival of young sea bass in nursery areas during the first years of life (Pawson, 1992; ICES, WGCSE 2014; Beraud *et al.*, 2018).

B.2.5. Natural mortality M

There are no direct estimates of natural mortality available for Northeast Atlantic sea bass. Predation up to around age 4 will be in and near estuaries and bays. As with other fish species it is expected that natural mortality will be relatively high at the youngest ages, particularly given the slow growth rate in sea bass. A variety of methods are given in the literature relating natural mortality rate M to life-history parameters such as von Bertalanffy growth parameters k and Linf (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The probability of encountering very old sea bass is partly a function of the interaction of year-class strength and sampling rates, as well as mortality, however the occurrence of sea bass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings. Age compositions of recreational fishery caught sea bass in southern Ireland, presented by stakeholders at IBP-NEW 2012, also show ages up to 26 years (Figure B.2.5.1). This stock has been subject to a commercial fishery ban for many years.

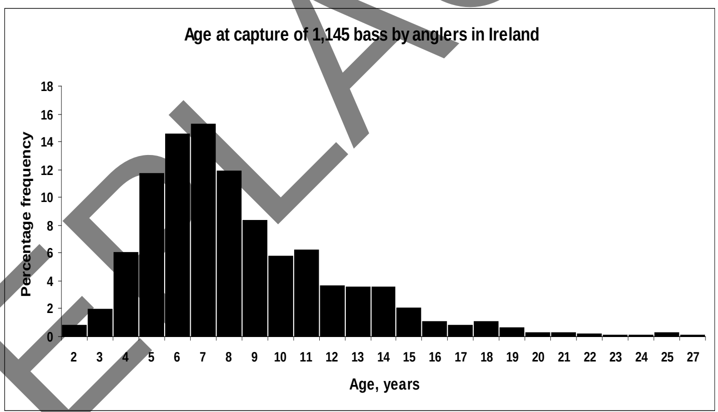


Figure B.2.5.1. Age composition of sea bass from samples collected from recreational catches in southern Ireland (data courtesy Ed Fahy, IBP-NEW 2012 meeting).

Inferences on sea bass natural mortality based on some life-history models in the literature are given in IBP-NEW 2012 benchmark assessment section. The inferred values of M, with the exception of the Beverton method, are in the range 0.15–0.22 (Armstrong, 2012). A variety of methods are given in the literature relating natural mortality rate M to life-history parameters such as von Bertalanffy growth parameters k and L_{inf} (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The method of Gislason *et al.* (2010) generates age-varying M values. These methods were applied to the following sea bass life-history parameters by Armstrong (2012):

LIFE-HISTORY PARAMETERS	
VBGF K (combined sex)	0.09699
VBGF Linf (combined sex)	84.55
VBGF t_0 (combined sex)	-0.73
Age at 50% maturity females (L_{50} converted to age)	6
Age at 50% maturity males (L_{50} converted to age)	4
Max age (combined sex)	28
Length at 50% mat females	40.65
Length at 50% mat males	34.67

The probability of encountering very old sea bass is partly a function of the interaction of year-class strength and sampling rates, as well as mortality, however the occurrence of sea bass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings although recreational fishing was occurring throughout this period. Age compositions of recreational fishery caught sea bass in southern Ireland, presented by stakeholders at IBP-NEW 2012, show ages up to 26 years. This stock has been subject to a commercial fishery ban for many years.

Inferences on natural mortality rates are given below:

Table B2.5.1. Inferences on natural mortality rate from a range of life-history based methods.

Source	Formulation	Combined sex M		
		tmax28	tmax 27	tmax26
Hoenig 1983	variety of taxa ln(M) = 1.44-0.982*ln(tmax);	0.160	0.166	0.160
	teleosts ln(M) = 1.46-1.01*ln(tmax)	0.149	0.154	0.160
	M= 4.899*tmax^-.916 (from 226 species)	0.231	0.239	0.248
Then *et al* 2015	M= 4.118*K^0.73. Linf^-0.33		0.173	
Alverson and Carney 1975	M = 3k/(exp(0.38*tmax*k)-1)	0.161	0.171	0.181
Pauly 1980	M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC))	0.196	TdegC=	12
		0.211	TdegC=	14
		0.224	TdegC=	16
Ralston 1987	M=0.0189+2.06*k	0.219		
Beverton 1992	M=3k/(exp(*am* *k)-1) am = age at 50% maturity	0.369	female *am* ; comb sex k	
		0.614	male *am* , comb sex k	
Jensen (1997)	M=1.5K	0.146		
			Gislason	Lorenzen
Gislason 2010	M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K))	age 1	1.599	1.210
Lorenzen	M=3*W^-0.288	age 3	0.539	0.644
		age 5	0.312	0.482
	Gislason: L = length at age from VBGF	age 7	0.221	0.402
	Lorenzen: W = mean wt at age from 2016 WGCSE SS3 run	age 9	0.175	0.355
		age 15	0.117	0.287
		age 20	0.100	0.262

Life history parameters	
VBGF K (combined sex)	0.097
VBGF Linf (combined sex)	84.55
VBGF to (combined sex	-0.73
Age at 50% maturity females (L50% converted to age)	6
Age at 50% maturity males (L50% converted to age)	4
Max age (combined sex)	28
Length at 50% mat females	40.65
Length at 50% mat males	34.67

Table B2.5.2. Inferences on natural mortality rate by age class using the Gislason *et al.* (2010) and Lorenzen (2006) methods. Values are given unscaled, and scaled to a mean M of 0.24 at ages 10–20 (based on Then *et al.* (2015) for maximum age of 27 years) and mean M of 0.15 at ages 10–20 (from Hoenig, 1983 using maximum age of 27–28 years).

	Gislason method M				Lorenzen method M			
age class	**L**	**Not scaled**	**Scaled to 0.24 at ages 10–20**	**Scaled to 0.15 at age 5–20**	**W (kg)**	**Not scaled**	**Scaled to 0.24 at ages 10–20**	**Scaled to 0.15 at age 5–20**
1	13.1	1.599	3.145	1.966	0.023	1.210	0.995	0.622
2	19.7	0.827	1.627	1.017	0.096	0.807	0.663	0.415
3	25.7	0.539	1.060	0.662	0.209	0.644	0.530	0.331
4	31.1	0.395	0.778	0.486	0.369	0.547	0.450	0.281
5	36.1	0.312	0.613	0.383	0.570	0.482	0.397	0.248
6	40.5	0.258	0.508	0.317	0.807	0.436	0.359	0.224
7	44.6	0.221	0.435	0.272	1.073	0.402	0.331	0.207
8	48.3	0.195	0.383	0.239	1.359	0.376	0.309	0.193
9	51.6	0.175	0.344	0.215	1.659	0.355	0.292	0.182
10	54.7	0.159	0.314	0.196	1.968	0.338	0.278	0.174
11	57.5	0.147	0.290	0.181	2.279	0.324	0.266	0.166
12	60.0	0.138	0.270	0.169	2.588	0.312	0.257	0.160
13	62.2	0.130	0.255	0.159	2.893	0.302	0.249	0.155
14	64.3	0.123	0.242	0.151	3.190	0.294	0.242	0.151
15	66.2	0.117	0.231	0.144	3.476	0.287	0.236	0.147
16	67.9	0.113	0.222	0.138	3.751	0.280	0.231	0.144
17	69.4	0.109	0.214	0.134	4.013	0.275	0.226	0.141
18	70.8	0.105	0.207	0.129	4.262	0.270	0.222	0.139
19	72.1	0.102	0.201	0.126	4.498	0.266	0.219	0.137
20	73.2	0.100	0.196	0.122	4.719	0.262	0.216	0.135
21	74.3	0.097	0.192	0.120	4.926	0.259	0.213	0.133
22	75.2	0.095	0.188	0.117	5.119	0.256	0.211	0.132
23	76.1	0.094	0.184	0.115	5.299	0.254	0.209	0.130
24	76.9	0.092	0.181	0.113	5.464	0.252	0.207	0.129
25	77.6	0.091	0.179	0.112	5.616	0.250	0.205	0.128
26	78.2	0.090	0.176	0.110	5.755	0.248	0.204	0.127
27	78.8	0.089	0.174	0.109	5.882	0.246	0.203	0.127
28	79.3	0.088	0.172	0.108	5.996	0.245	0.201	0.126
mean over ages 10–20		0.122	0.240	0.150	3.422	0.292	0.240	0.150

IBPNEW 2012 (ICES, 2012) applied a range of life-history based methods to make inferences of appropriate values for natural mortality (M). The historical value of 0.15 reflected the results of the Hoenig (1983) method based only on a maximum observed age of 28 years from a large dataset of age readings collected by Cefas (UK) from the 1980s onwards. A maximum observed age of 26 years was recorded in a dataset of 1145 age readings from fish provided by southern Ireland anglers (ICES, 2012). WKBASS 2018 has updated the life-history analyses using information from additional and more recent studies, and has considered the use of an age-dependent method combined with methods based on maximum observed age.

The inferred values of M (Table B2.5.1–2), with the exception of the Beverton method, are in the range 0.12–0.29. The average of the Gislason estimates unscaled for ages 10–20 is 0.12, and the estimates fall below 0.15 by age 16. The Lorenzen M estimates given in Table B2.5.2 out to 28 years of age generates larger M values, but when re-scaled to M=0.15 or 0.24 at ages 10–20 the resultant M at-age is more closely matched. The values of M from the Then *et al*. (2015) estimators are given in Table B2.5.1 compared with the estimators used previously for the sea bass assessment. Values of M for tmax values of 26–28 range from 0.23–0.25. The Then *et al*. (2015) method based on VBGF parameters is 0.173. These are larger than given by the Hoenig (1983) tmax method for teleosts, and in the range given by Alverson and Carney (1975), Pauly (1980), Ralston (1987). The more recent published study by Then *et al*. (2015) lookeed at the link between M and maximum observed age. In this paper, they analysed data from 226 studies (including Hoenig, 1983) to evaluate the robustness of life-history based M inferences. After exploring the different options for M, WKBASS 2017 agreed the the M value from Then *et al*. t_{max} method (M=0.24) was more appropriate and is close to the value given by the assessment model if allowed to freely estimate the parameter. WKBASS2 2018 has adopted this value.

B.3. Surveys

B.3.1. UK Solent and Thames prerecruit surveys

The UK has conducted prerecruit trawl surveys in the Solent and the Thames Estuary since 1981 and 1997 respectively. These surveys all ended in 2009 although the Solent survey was repeated as a one-off survey in autumn 2011 to help provide recruitment indices for the sea bass benchmark assessment. The location of the surveys and the tow positions are shown in Figure B.3.1.1. Both surveys use a high headline sea bass trawl, although in the Thames it is deployed as a twin rig and in the Solent as a single rig.

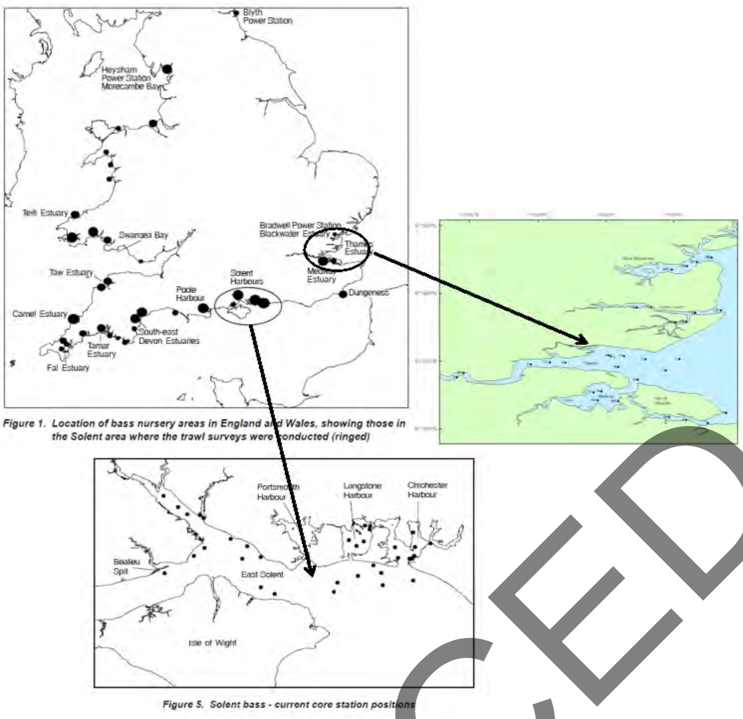


Figure B.3.1.1. Location and tow positions for UK(England) Solent and Thames sea bass surveys.

The Solent survey has previously been presented to WGNEW 2012 as a combined index across ages in each year class. The index was derived by first rescaling the annual mean catch rate per age class to the mean for that age in the survey series, then taking the average of the rescaled values for ages 2–4 in each year class from surveys in May–July and September (i.e. up to six values represented in the annual combined index). The Thames survey data were worked up in the same way, although using a different age range for the combined index (ages 0–3). WGNEW 2012 provided the survey data in the more conventional tuning-file format, giving the standardised catch rates (arithmetic mean numbers per 10 minute tow) by year and age, separately for the two surveys (data in assessment report). These surveys have now been discontinued and will not be updated by future working groups unless new resources are allocated.

The spring and autumn Solent survey index series are updated to include the autumn 2013 survey and to amend an error in the autumn survey indices in 2000. The surveys do not show major year-effects, but as noted in previous assessments the autumn (September) survey shows a general increase in recruitment during the 1990s up to the mid-2000s, with very low indices for the 2008 onwards year classes, whilst the spring survey shows poor recruitment from around 2002 onwards. Previous Stock Synthesis runs show that the autumn survey is much better fitted than the spring survey. The spring survey is likely to be more strongly affected by weather and by temperature effects on distribution.

The Thames survey series indicates an increase in recruitment from the mid-1990s to early 2000s followed by some poor year classes, possibly a strong 2007 year class, then weak year classes in 2008 and 2009. A problem with the use of the Thames survey is that it may reflect recruitment from spawning that became established in the southern North Sea as the stock expanded in the 1990s under warmer sea conditions, and may therefore not reflect recruitment trends that influence the larger stock components in the Channel and Celtic Sea.

A justification of using the Solent survey as an index of recruitment over the full range of the stock was the results of a statistical, UK-only fleet-based separable model developed by Pawson *et al*. (2007) and updated by WGNEW 2012 (Kupschus *et al*., 2008). The Pawson *et al*. (2007) model was fitted only using UK age compositions for trawls, midwater trawls, nets and lines, separately for ICES divisions 4.b–c, and 7.d, and 7.e, 7.h and 7.a, 7.f, 7.g, and was intended mainly to estimate fleet selection patterns. Although it excluded any tuning data, the recruitment series for each sea area closely resembled the Solent survey indices and to an extent the shorter Thames series, and was able to provide coherent selection patterns by fleet.

The full Solent survey series was subject to a change in gear design in 1993. Some comparative trawling was carried out to develop age-varying calibration factors, but these are poorly documented. Pending an evaluation of this, the first benchmark Stock Synthesis runs included a sensitivity run with the series split into two periods around the gear change. Some additional issues with calibration factors applied to the spring survey were detected during the benchmark, and this is considered later in the sections on model development.

A precision estimate was calculated for the Solent and Thames surveys based on the between-tow variations in catch rate of all the age classes used in the index. For the Solent spring, Solent autumn and Thames surveys, the relative standard errors were 0.42, 0.25 and 0.43 respectively.

IBP-BASS 2014 reviewed the performance of the Solent and Thames surveys and decided to exclude the Solent spring and the Thames survey for the following reasons:

- The Solent spring survey (Table B.3.1.1) has performed poorly in the assessment, indicating trends in recruitment not in accord with other data. This may be related to temperature or other environmental effects on distribution of small sea bass in spring. Unusual calibration factors noted in some years in the Solent spring data files require investigation.
- The Thames survey (Table B.3.1.2) may reflect recruitment from spawning that became established in the southern North Sea as the stock expanded in the 1990s under warmer sea conditions, and may therefore not reflect recruitment trends that influence the larger stock components in the Channel and Celtic Sea.

The removal of these surveys has negligible impact on the estimated stock trends.

Table B.3.1.1. Time-series of relative abundance indices for sea bass age groups 2, 3 and 4 from the UK Solent spring and autumn trawl surveys. A change in trawl design took place in 1993.

	May–July			September		
Year	age 2	age 3	age 4	age 2	age 3	age 4
1981	0.00	0.30	0.25		No survey	
1982	0.51	2.17	0.16	3.25	10.10	0.38
1983		No survey		9.87	0.91	1.88
1984	0.95	2.66	0.43	1.38	0.65	0.09
1985	0.00	10.33	2.56		No survey	
1986		No survey		0.27	4.26	1.31
1987	0.00	0.42	3.18	0.05	0.28	2.27
1988	0.00	0.02	0.47		No survey	
1989		No survey		6.68	0.37	0.00
1990	2.84	2.48	0.00	2.81	1.15	0.02
1991	5.78	0.62	0.09	3.08	0.21	0.03
1992	0.11	7.04	0.35	0.95	18.59	0.16
1993	0.05	7.33	14.02	6.65	3.59	4.39
1994	0.04	1.63	1.14	3.33	1.84	0.29
1995	0.05	1.57	0.97	4.83	4.69	0.72
1996	1.43	4.09	3.36	5.52	0.43	0.11
1997	0.27	1.94	0.11	33.62	4.52	0.06
1998	0.00	6.75	5.79	1.22	5.50	0.61
1999	0.61	0.95	12.30	19.37	0.67	0.87
2000	0.49	37.03	1.06	6.07	11.35	0.03
2001	1.71	6.33	3.43	34.42	3.92	1.57
2002	0.63	1.62	0.29	7.42	3.87	0.40
2003	0.06	0.32	0.38	8.37	4.60	0.59
2004	0.17	0.28	0.16		No survey	
2005	0.05	0.42	0.35	13.12	7.98	0.84
2006	0.44	2.47	1.03	9.51	9.21	1.02
2007	0.33	0.50	0.50	3.42	1.78	0.30
2008		No survey		18.52	6.66	0.34
2009	0.72	1.03	0.13	13.25	6.25	0.33
2010		No survey			No survey	
2011		No survey		2.25	1.39	0.42
2012		No survey			No survey	
2013		No survey		1.34	0.08	0.10
2014		No survey		0.74	0.64	0.02
2015		No survey		6.95	0.44	0.05
2016		No survey		3.75	2.17	0.11

Table B.3.1.2. Time-series of relative abundance indices for sea bass age groups 0–3 from the UK Thames trawl survey.

Year	age 0	age 1	age 2	age 3
1997	7.737	0	0.048	0.41
1998	No survey			
1999	19.54	6.033	0.764	0
2000	4.015	14.74	0.832	0.089
2001	121.5	11.47	5.108	0.171
2002	469	20.71	2.716	1.093
2003	225.6	35.76	4.429	0.159
2004	238.92	44.99	7.32	1.03
2005	37.04	14.49	6.86	0.75
2006	245.54	11.26	3.46	0.94
2007	No survey			
2008	107.55	50.69	1.86	0.2
2009	95.43	7.79	13.59	0.91

B.3.2. Other 0-gp & 1-gp surveys

The UK has undertaken a seine net survey in the Tamar Estuary, since 1985. Additional data are available from the Camel estuary and power stations in the Thames and Severn Estuary. These surveys are used as supporting information and not included in the assessment. Abundance indices for these surveys are given in Table B.3.2.1. The Tamar survey abundance indices need to be updated to include more recent surveys. Seine net surveys in the UK estuaries Fal and Helford also have data on 0-gp and 1-gp sea bass.

Table B.3.2.1. Abundance indices for 0-gp and 1-gp sea bass. († discontinued).

	Estuary seine surveys			Power station screen	
	Tamar (0-group)	Tamar (1-group)	Camel	Severn	Thames
	7.e	7.e	7.f	7.f	4.c
1972				3	
1973				4	
1974				1	
1975				15	78
1976				127	100
1977				-	6
1978				-	5
1979				-	5
1980				9	37
1981			2	216	21
1982			123	83	56
1983			30	226	83
1984			134	8	62
1985	0.663	0.385	22	11	76
1986	0.005	0.014	1	3	14
1987	0.032	0.062	31	96	116
1988	1.484	1.284	48	98	54
1989	2.348	2.389	112	446	610
1990	1.038	1.516	89	25	433
1991	0.076	0.058	50	300	64
1992	2.216	2.431	25	280	104
1993	1.013	0.913	22	202	131
1994	1.126	0.346	134	-	26
1995	2.356	1.294	-	-	27
1996	0.102	0.047	119	242	†
1997	1.119	1.299	102	†	
1998	2.082	3.170	264		
1999	1.215	0.937	56		
2000	0.340	1.185	133		
2001	0.351	0.129	†		
2002	2.098	3.179			
2003	0.965	1.067			
2004	1.453	0.261			
2005	0.522	0.169			
2006	0.186	0.203			
2007	0.475	1.308			
2008	1.275	1.229			
2009	0.460				

B.3.3. Evhoe survey: France

Sea bass are caught in small numbers in the French Evhoe trawl survey, which extends to the shelf edge in subareas 7 and 8 but also extends into coastal areas of the Bay of Biscay and the Celtic Sea where sea bass may be caught (cf the station map, Figure B.3.3.1). Less than 10% of the stations have sea bass catches in most years. A mean of 0.5 sea bass per trawl has been recorded from 1987. Abundance indices are calculated as stratified means.

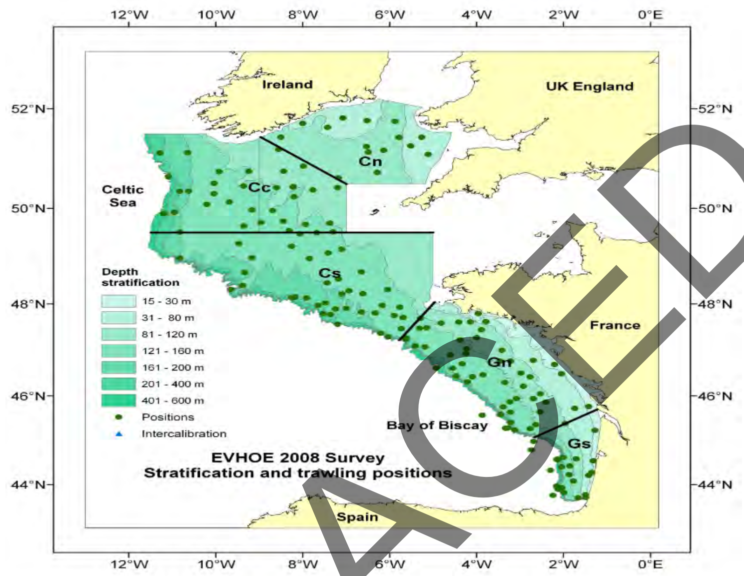


Figure B.3.3.1. Station positions for French Evhoe bottom-trawl survey (not used in assessment).

B.3.4. Channel Ground Fish Survey (CGFS): France

Raw data on sea bass from the French scientific trawl survey "Channel Ground Fish Survey - CGFS" were not available for the previous benchmark in 2012 (IBP-NEW 2012). Details of the survey are given in Coppin *et al.* (2002), which includes a full description of the GOV trawl used in October each year at the 82 stations in ICES Division 7.d shown in Figure B.3.4.1. The majority of sea bass are caught in the coastal waters of England and France (Figure B.3.4.1). The abundance indices from all the stations give similar trends as from a subset of stations in the main coastal areas, and trial runs with SS3 gave similar trends. Therefore, for further SS3 development, the indices calculated from all the area are used.

The abundance indices are calculated applying a stratified random swept-area based estimator. Strata correspond to ICES statistical rectangles. Swept-area is calculated using wingspread. As this is a stratified swept-area based indicator, uncertainty is based on between haul variance within a strata and summation of variances across strata. Full methodology is presented in the WD_01, available in Annex 2 of the IBPBASS 2014 report. The trends in both the index and in the proportion of stations with sea bass show some similarities to the trend in total biomass estimates from the WGCSE 2013 update assessment using Stock Synthesis, which lent *a priori* support to the use of the index in the assessment. The swept-area indices of abundance, the percentage of stations with sea bass, and the variance of the estimates are included in the WGCSE 2014 report and will be updated annually. The length composition of the survey index is calculated and is also input to Stock Synthesis.

The precision of the swept-area indices appears unrealistically high in some years (e.g. 0.025 in 1991), which may indicate that the index trends are driven largely by the incidence of positive catches. Modelling of the data using delta lognormal models may provide more realistic precision. During trial Stock Synthesis runs, the use of the CVs resulted in an inability to fit the selection curve for the survey due to individual years being given far too much weight. Relaxing the CVs to 0.30 for all years except the first three years (set to 0.6 given the very low incidence of positive stations) allowed the model to fit the length compositions more closely over the series. The annual indices are therefore input to Stock Synthesis with a CV of 0.30 for all years. The effective sample sizes for the annual survey length composition data are set at the number of stations with sea bass length data. The length compositions for the first three years (1988–1990) are excluded from the assessment due to very small sample sizes although the aggregate indices are retained.

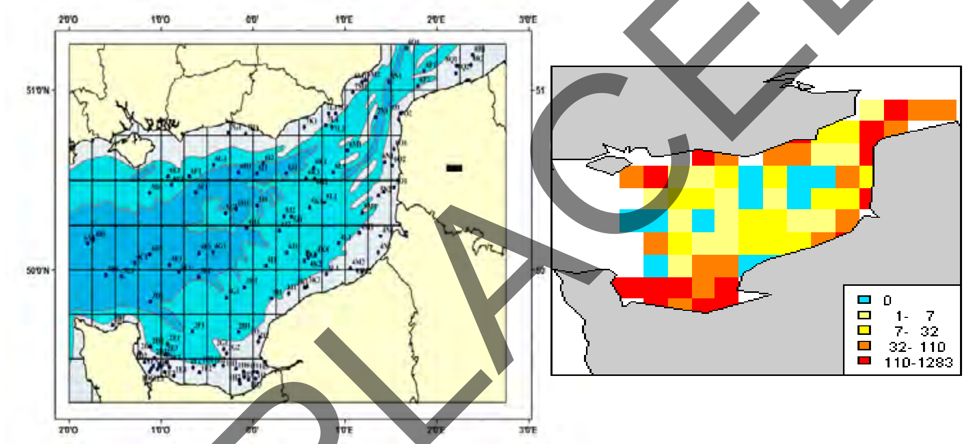


Figure B.3.4.1. Left: stations fished during the Channel Groundfish Survey carried out annually by France. Right: distribution of total catches of sea bass over the survey series.

B.4. Commercial lpue

IBP-NEW2012 evaluated a range of commercial fishery lpue series for French and UK fleets operating in areas 4 and 7. The UK analysis of official catch statistics involved filtering individual trip data to include only trips in ICES rectangles where sea bass catches have been recorded historically. UK vessels of 10 m and under, for which historical landings data are very uncertain, were found to have a wide range of lpue trends depending on gear and area fished, often showing a very steep increase since the mid-2000s (Armstrong and Maxwell, 2012). This may be partly a consequence of more accurate reporting caused by the Registration of Buyers and Sellers regulations after its introduction in 2005, but may also represent a bias caused by increased targeting of sea bass by vessels with insufficient quotas for other stocks or trying to develop track record.

With some exceptions (e.g. trawlers in 7.d), UK >10 m vessels tended to show different lpue trends to 10 m and under vessels. Relative trends of sea bass lpue for 70–99 mm mesh UK otter trawls (1985–2011) and French otter trawlers (2000–2010) operating in 4.b–c, and 7.d, and 7.e, 7.h and 7.a, 7.f–g showed a general trend of increase in the 1980s and 1990s, followed by a levelling off and a decline after 2009 (Figure 10.1.2.7, from

WGCSE 2013). The trends for >10 m UK and French trawlers in 4 and 7.d and in 7.e closely matched the trend in total-stock biomass estimates from the final WGCSE 2013 Stock Synthesis assessment whereas the UK trawlers in 7.a and 7.f–g had a much lower lpue in the early part of the time-series. These results indicated a potential for development of fishery lpue series for inclusion in development of SS3 for sea bass, using more sophisticated trip filtering and using more statistical approaches such as delta-lognormal modelling with GLMs to develop standardised series.

B.4.1. UK sea bass logbook scheme

The UK sea bass logbook scheme is described in Section B.1.1. Although the survey has severe limitations for estimation of total sea bass landings for UK vessels, individual logbooks provide time-series of varying duration on catch rates of individual vessels using specific gears. The logbooks with sufficient data cover eight gear types within trawls, nets and lines, covering mainly 10 m and under vessels, excluding recreational vessels. The total numbers of logbooks have declined from 50–60 in earlier years to below 20 in recent years. No logbooks were issued in 2008:

	Year														
Region	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	7	9	11	19	9	8	15	16	15	22	16	14	18	16	16
2	0	10	10	15	17	14	13	23	10	25	24	20	24	19	17
3	2	4	6	5	7	7	4	6	7	6	9	3	8	5	3
4	5	5	7	9	7	8	7	11	11	4	6	4	4	4	4
5	7	6	10	13	9	9	10	18	8	10	9	7	11	12	11

	Year									
Region	2000	2001	2002	2003	2004	2005	2006	2007	2009	2010
1	16	19	14	12	13	8	6	0	3	3
2	15	15	13	14	7	10	5	0	3	2
3	2	5	3	5	5	5	7	0	3	3
4	4	5	6	7	1	3	4	0	3	1
5	9	10	9	4	2	5	6	2	1	1

(Region 1: North Sea 4.b–c, 2: eastern Channel 7.d; 3: western Channel 7.e, 7.h; 4: Celtic Sea (7.f–g); Irish Sea (7.a). The trend in number of records per year shows roughly the same pattern across gears:

An exploratory GAM method was developed (Armstrong and Maxwell, 2012) to extract a common temporal trend in lpue from the individual series for ICES areas 4.b–c, and 7.d, and 7.e, 7.h and 7.a, 7.f–g (referred in the models as areas 1 and 2, 3 and 4 and 5). This is analogous to combining series of tree ring counts from timbers of various ages to give a single series describing climate changes. The general method involves estimating logbook factors and year factors (and interactions) to minimise residual model error. Following initial model development and evaluation, a negative binomial error distribution with log link was selected. This can accommodate zero values and allows for the variance to increase with the mean. Working with a log link implies that the estimated trend with year is multiplicative not additive.

Fitted trends and confidence intervals suggest an increasing lpue trend in regions 1 and 2 (North Sea and 7.d), and 3 (7.e, 7.h) (Figure B.4.1.1). A relatively flat trend and possible recent decline is indicated in regions 4 and 5 (7.a, 7.f–g) although the recent trend is highly imprecise. Residual checks indicate the model assumptions are reasonable. Model diagnostics and sensitivity to smoothing and other parameters are given in Armstrong and Maxwell (2012).

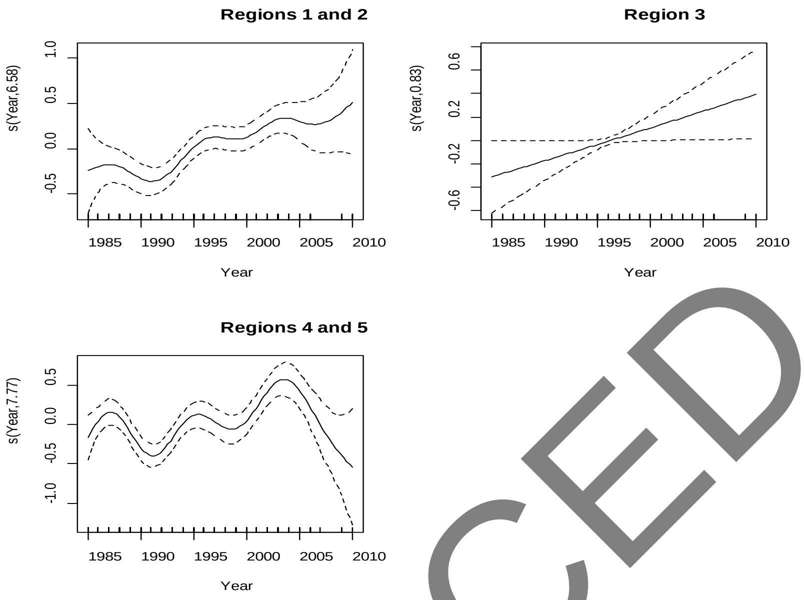


Figure B.4.1.1. Cefas sea bass logbook lpue: Selected model for combined regions, plots showing year effects from a fitted model with separate mean value for each book number–gear combination and negative binomial error distribution, dashed lines are a 95% confidence interval.

B.4.2. UK fleet lpue based on official catch dataseries

Armstrong and Maxwell (2012) review trends in UK commercial fishery lpue for sea bass in the North Sea (4), eastern Channel (7.d), western Channel (7.e) and Irish/Celtic Seas (7.a, 7.f–g) from 1985–2011, and evaluate the possibility of using the time-series as relative abundance estimates for tuning stock assessment models.

Gears which catch sea bass are targeted at a variety of species, and the fishing effort is distributed across many areas where sea bass have zero or very low probability of capture. A number of approaches are possible to subset fishing trips to include only those that have a probability of catching the species for which lpue is to be estimated. One approach (Stephens and MacCall, 2004) is to cluster fishing trips according to species that occur in association, and use only the cluster with the species on interest for estimating lpue. This method has not yet been applied to UK data. An alternative method to subset trips was applied. This involved (a) selecting gear types that account for ~95% of the total sea bass landings in each area since 2005; (b) for the selected gears and areas, identify ICES rectangles accounting for ~95% of the total sea bass landings since 1985. Annual lpue was then estimated for each area and gear, separately for vessels of 10 m and under (LOA) and >10 m vessels. The LOA split is important because reporting of landings and effort of 10 m and under vessels has been very uncertain historically, particularly prior to the introduction of Buyers and Sellers regulations in 2005. Lpue of 10 m and under vessels may be very inaccurate prior to 1995.

It was not possible to evaluate the effect of any increase in targeting of sea bass by individual vessels using the selected gear types in the selected rectangles, or effects of technology creep. Increased targeting is likely to have happened for vessels with increasingly limited quotas for other species such as cod and which have switched to non-TAC species such as sea bass. For some gears, such as beam trawls, sea bass are not targeted and are purely a bycatch. Too many lpue series have been examined to reproduce in the Stock Annex, but can be viewed in Armstrong and Maxwell, 2012.

B.4.3. French lpue dataseries

Lpue of French trawlers in 4.b, 4.c, 7.d, 7.e and 7.h is available from 2000 with estimated landings by ICES divisions. A recent study has developed indices as kg/per day based on data from auction's sales. This study was carried out on French bottom trawlers (less than 18 m), having a fishing strategy with the least distant random sampling; this fleet is considered as a fleet that does not target sea bass. Large bias can be caused where: 1. an auction sale corresponds to several days of fishing, 2. technological advances are not taken into account, and 3. changes in fisher strategies are excluded. Nevertheless, for information, those from the Channel and North Sea have been compared to the UK Otter trawls lpue, and similarities shown on Figure B.4.3.1 are observed.

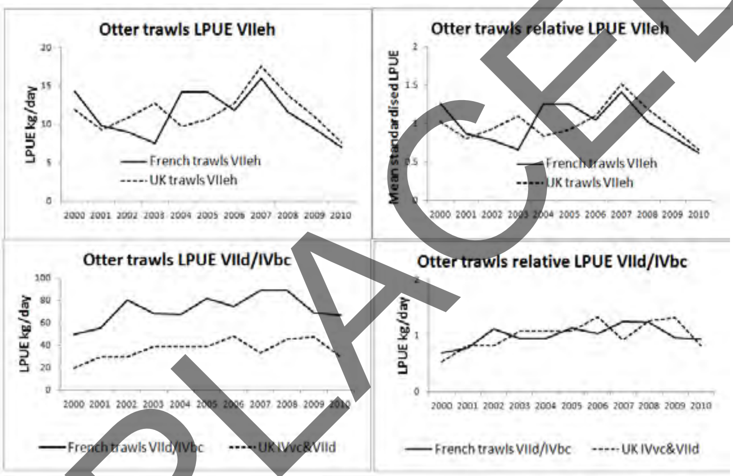
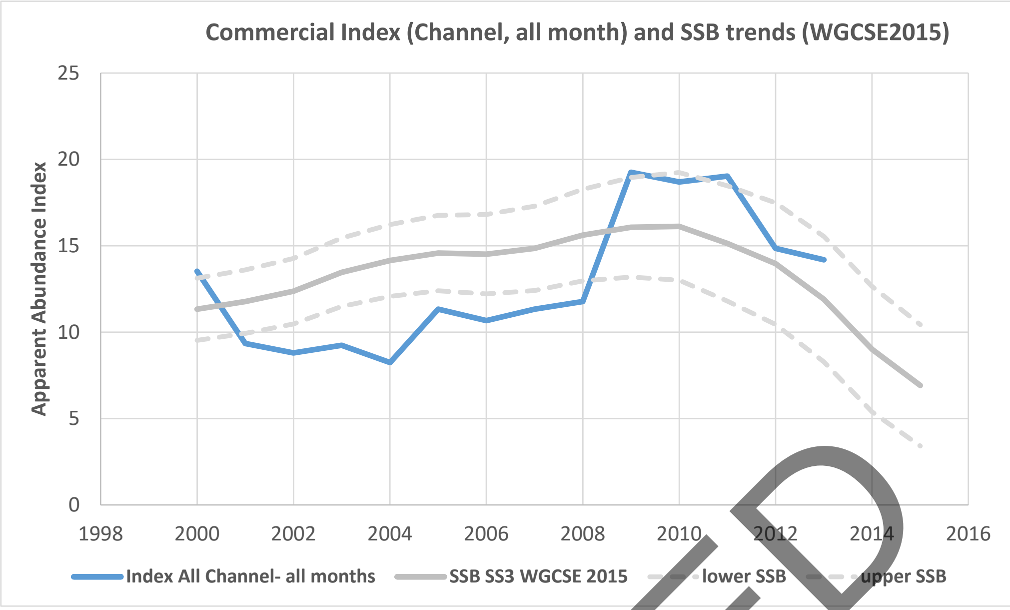


Figure B.4.3.1. UK fleet lpue based on official catch dataseries, compared to the French lpue sets based on auction hall sales.

In 2015 for WGCSE, a study was conducted and presented in a Working Document (ICES, 2015a). Daily catch rates per vessel, grouped within months and ICES statisitcal rectangles, were analysed using a multiplicative two factors model. The two factors were the fishing vessel effect and the stratum effect. A stratum corresponds to an ICES statistical recangle, a month and a year.

First conclusions provide a basic hypothesis about stock structures and spawning migrations, and directly related to this discussion apparent abundance index have been produced covering various option/areas. The preliminary results of the study are considered promising by the group. Even if it's still underdevelopment and should be benchmarked to use it directly in the assessment, some comparison of the Index from two various option with the SSB is presented in Figure B.4.3.2. This shows similar trends in stock perception conforting results of the assessment (but question on the degree of the trends).



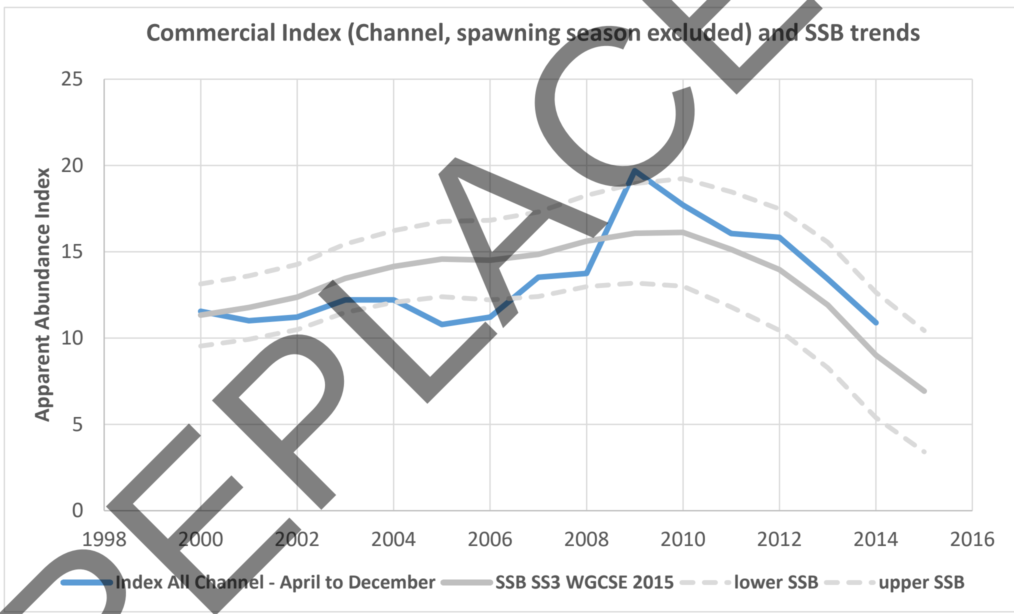


Figure B.4.3.2. Bass-47: Trends in commercial lpue index for French fleets overlaid on the assessment estimates of spawning–stock biomass (+/- 2 standard errors). Top: index based on data from all twelve months; bottom: index excluding fishing trips during spring-spawning season.

A new time-series of relative abundance indices since 2001 was developed by statistical modelling of French fishery landings per unit of effort (lpue) and provided to WKBASS data WK 2017. The data were fitted closely by the assessment model. During the subsequent WKBASS benchmark assessment meeting in 2017, a new index series was provided for each of the stocks, excluding a large number of vessels with predominantly zero landings of sea bass. The index combines trends from otter trawls, nets and lines, but excludes midwater trawls which target spawning aggregations and have not fished on the stock since 2014.

WKBASS2 2018 has included in the assessment the French fishery lpue series 2001–2016 with modelling of zero trip landings, Figure B.4.3.3. Several alternative series were also considered (2001–2016 including modelling of zero catches and alternative series using positive catches only; 2010–2016 including modelling of zero catches).

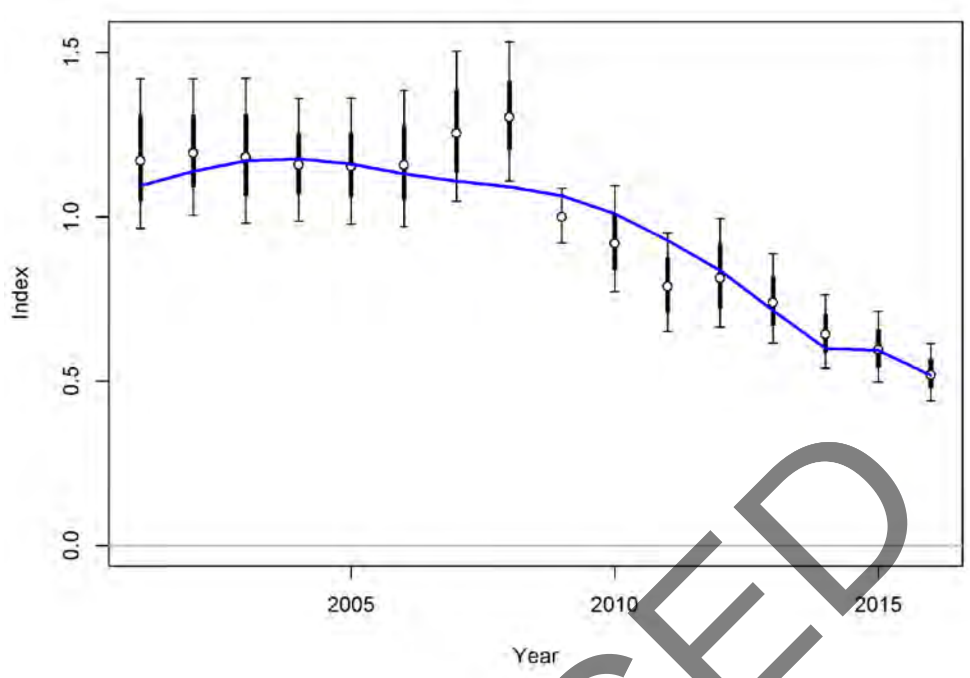


Figure B.4.3.3. Bass-47: Final accepted commercial lpue index for French fleets (+/-2 standard errors).

C. Assessment: data and method

C.1. Software used and model options chosen

Model used: Stock Synthesis 3 (SS3) (Methot, 2000)

Software used: Stock synthesis v3.24u (Methot, 2011)

WKBASS2 2018 revised the assessment using Stock Synthesis 3 (SS3) framework (Methot, 2000) and the software used was Stock synthesis 3.24u (Methot, 2011). The assessment requires a modelling framework capable of handling a mixture of age and length data for fisheries and surveys (fleet-based landings; landings age or length compositions, age-based survey indices for young sea bass) and biological information on growth rates and maturity. Landings-at-age were available for four UK fleets from 1985 onwards, whereas French fleets had length composition data that were available only since the 2000s. The Stock Synthesis assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html.

A mixed age–length model was fitted by WGCSE 2013 as the base case, with a length-only model for comparison. Some adjustments were made by WGCSE 2013 to the model: i) UK fishery compositions for 2012 were input to the age–length model as length compositions because age compositions were not available; ii) the UK midwater trawl series was reduced to 1996 onwards and was input as length compositions because unusual length-based selection curve parameters were obtained when inputting the data as age compositions; iii) recruit deviations were estimated back to 1965.

IBP-BASS 2014 addressed the following recommendations of WGCSE 2013 for developing the assessment during the inter-benchmark meeting. Work completed is indicated in parentheses:

- Source and review information on historical catches and develop plausible scenarios including over the 20+ year burn-in period for the assessment [*some investigations were pursued in France but yielded no clear information on pre-1985 landings*];
- Review the derivation and quality of historical fishery length/age composition data [*not done beyond the information on sampling intensity and coverage already available*];
- Expand UK fishery age compositions to all true ages [*done, see below*];
- Rationalise the fleet definitions, and reduce to the minimum sufficient to provide robust SS3 stock trends [*done, see below*];
- Source and evaluate candidate lpue or effort series for tuning abundance or fishing mortality on older ages [*fishery-dependent abundance indices were not considered other than some information presented in Section 2 on lpue of fleets in the Netherlands*];
- Collate and evaluate other survey data on sea bass abundance that could be incorporated in the model [*French Channel Groundfish Survey was evaluated and incorporated in the assessment*];
- Determine the most robust approach to incorporating mean length-at-age and length-at-age distributions in SS3 [*Not done*];
- Investigate potential biases in using combined sex growth parameters [*Not done*];
- Further explore the sensitivity of the assessment to decisions on model structure and inputs [*See model development and sensitivity analyses carried out below*];
- Consider if simpler assessment approaches are warranted [*IBPbass focused exclusively on Stock Synthesis to try to make best use of all available data*].

IBP-BASS2 2016 reviewed the quality and use of a new age composition dataset for French fishery landings, updated some input data, and made a number of improvements in the SS3 model configuration use. The base case was the SS3 model configuration used by WGCSE 2015. The base case including agreed adjustments was used to explore the performance of a series of runs. IBP-BASS2 2016 concluded that model with sample sizes adjusted using the Francis method (an iterative reweighting process of compositional data using the input sample sizes and the effective sample sizes based on model fit) could be taken as the agreed approach for use in future update assessments for sea bass.

The model considered by IBP-BASS2 2016 as suitable included theses key updates:

- Fixing all growth parameters of the von Bertalanffy growth equation.
- Inclusion of French age data.
- Inclusion of UK length data.
- Combining the UK Autumn Solent sea bass survey into one index.
- Separation of the UK trawls/nets and lines into two fleets and inclusion of the recreational catch at a separate fleet.

- Revision of input effective sample sizes using the Francis method.
- Using an emphasis factor (lamda) of 0.5 each for length and age composition data.

Full details of the reasons for these changes, and diagnostics of model fits with these changes included, can be viewed in the IBP-BASS2 2016 report. Information is given on some of the key decisions of IBP-BASS2 2016 concerning the final structure of the assessment model.

The cessation of French pelagic trawl fishery on spawning aggregations due to bad weather in 2014 and management controls since 2015 were explicitly modelled WKBASS 2017 by allowing for a change in French fishery selectivity in those years. Within WKBASS 2018, selectivity and retention blocks were included from 2015 onwards for UK and French fleets and some correlated selectivity parameters fixed.

Plus group

UK fishery age composition data show year-class structure extending well beyond the eleven years, previously used in the assessment of this stock. IBP-BASS 2014 carried out runs with plus groups set at 12+, 16+, 18+ and 20+. The 16+ setting appeared sufficient to improve estimation of early recruit deviations prior to 1985, without causing problems of zero catch estimates appearing in the data file at old ages. All further assessments were conducted with 16+ group.

Selectivity patterns for UK commercial fleets

The WGCSE 2013 assessment treated all commercial fleets from the UK and France as having asymptotic length-based selectivity. This reduced the number of parameters per fleet to only two, an important consideration when four UK fleets and one French fleet were being modelled. Having collapsed the UK trawls, nets and lines to a single fleet, IBP-BASS 2014 explored the use of a double normal selectivity pattern, which appeared to be appropriate to trawls and nets from the results of the Pawson *et al.* (2007) and Kupschus *et al.* (2008) separable model applied to separate UK fleets.

The form of the selectivity pattern was investigated initially using a simple cohort analysis applied to the aggregated catch-at-age for the four UK fleets since 2013. The terminal F for this aggregate "pseudo cohort" was adjusted until the pattern of partial F's for the UK midwater trawl and lines fleets were as close as possible to asymptotic, as these fleets target a wide range of adult and juvenile sea bass in inshore and offshore waters. The pattern of partial F's for the trawls and nets fleets were then revealed as being strongly domed, confirming previous results in the Pawson *et al.* (2007) separable model. Input initial parameters and bounds for a double-normal selectivity function (a selectivity form recommended in the Stock Synthesis manual) were derived for UK trawls, nets and lines using the spreadsheet developed for Stock Synthesis. The fitted selectivity for this fleet and for the midwater trawl fleet in the update Stock Synthesis run closely match the selectivity patterns given by the empirical approach using cohort analysis.

The WGCSE 2014 update assessment uses the same selectivity models and input selectivity parameters as agreed by IBP-BASS 2014, fitting the parameters using soft bounds rather than priors with hard bounds. This resulted in fitting ten selectivity parameters for commercial fleets (six for UK trawls, nets and lines, and two each for midwater trawls and combined French fleets. The "other fleet" was assumed to have the same selectivity as the French fleet).

In WKBASS 2018, selectivity and retention blocks were included in the assessment from 2015 onwards for UK and French fleets and some correlated selectivity parameters were fixed.

Natural mortality and stock–recruit steepness

The value (or vector) of natural mortality used in an analytical assessment is a key parameter determining the estimated productivity, abundance and MSY or other reference points (RPs). The assumed shape of the stock–recruit curve acts with the assumed M to constrain any possible biological reference points (Mangel *et al*., 2013). A key parameter defining a stock–recruit curve is steepness, defined as the ratio of recruitment from an unfished population to recruitment when the spawning–stock biomass is at 20% of the unfished level.

IBP-BASS 2014 explored the performance of the Stock Synthesis model for a range of different values for natural mortality and stock–recruit steepness, using a similar model formulation to the WGCSE 2014 update, but excluding the recreational fishing mortality vector. The total of negative log likelihood was compiled for the range of combinations, along with the SSB depletion in 2013 from the virgin SSB, and the relative standard error of the SSB in that year.

Total negative log likelihood tended to be lowest at steepness values approaching unity, with the greatest tendency at low values of M, and likelihood also decreased with increasing M. Despite the lower value of negative log likelihood, the relative standard errors of the SSB estimates for 2012 (from the inverse Hessian) increased with increasing M but were almost unaffected by steepness (RSE values at steepness 0.999 were 0.158 at M=0.15; 0.164 at M=0.20; 0.175 at M=0.25 and 0.199 at M=0.30). The unusual value at steepness 0.8, M=0.3 was a result of the selectivity curve for the combined UK trawls, nets and lines flipping from a domed to an asymptotic pattern. Otherwise, the values show smooth relationships with input M and steepness.

The depletion of SSB in 2013 compared with the virgin SSB was progressively lower as M was increased, but was far less sensitive to steepness.

Recruitment of sea bass has varied widely in response to environmental factors including conditions in the estuarine and other inshore nursery habitats. There is almost no information to indicate declining recruitment at lower SSB and to discern the true value of steepness. A wide range of values appears plausible, though the model fit slightly favours the (biologically implausible) steepness value of unity.

IBP-BASS 2014 decided to retain a fixed steepness value of 0.999 given the relative insensitivity of the assessment to this parameter. This means that F or biomass at MSY cannot be estimated, and that proxy F_{MSY} reference points have to be specified.

IBP-BASS2 2016 explored the sensitivity of the model to a steepness value of 0.7. The results showed very little sensitivity to this value with just a minor revision downward for SSB and upward for $F_{5–11}$.

The tendency for likelihoods to improve with increasing M, despite the inferences that a relatively low M is consistent with sea bass life-history traits and maximum age approaching 30 years, however suggested that additional mortality associated with the recreational fishery could perhaps be accommodated within the model. Incorporating information on recreational fishery catches.

WKBASS assessment WK 2018 documented and reviewed all the available recreational catch estimates for sea bass in areas 4.bc, 7.d.e–h (Hyder *et al*., 2018; Table 4.2.6.2.1).

Removals estimates were reworked for the 2012 reference year as the sum of retained fish and released fish with PRM of 5% applied (Table 4.2.6.2.1). A length composition for recreational removals for the 2012 reference year was compiled for this year as described in detail in the Hyder *et al*. (2018), and included in the Stock Synthesis data file (Figure 4.2.6.2.1).

Table 4.2.6.2.1. Recreational removals (tonnes) by country for 2012. PRM indicates fish that die after release, applying post-release mortality of 5% as used in the WKBASS assessment WK 2018.

Country	Year	Retained	PRM	Removals
France	2009–2011	940	17	957
Netherlands	2010–2011	138	3	141
England	2012	332	10	343
Total	2012	1410	29	1440

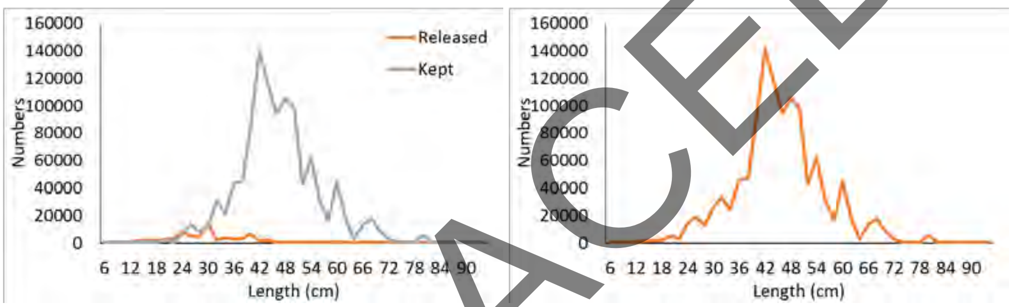


Figure 4.2.6.2.1. Length frequency of recreational fishery removals for the 2012 reference year, derived from surveys in France, Netherlands and England. PRM are total released catch with post-release mortality of 5% applied. Right hand plot is the total removals used in the Stock Synthesis model to estimate selectivity.

The implementation of management measures should lead to a reduction in fishing mortality as more and larger fish are released. This means that it is not appropriate to assume constant recreational fishing mortality, so it was necessary to include an estimate of recreational catch or change in fishing mortality after 2015. However, coverage of surveys was patchy for all countries after 2015, with only provisional estimates available for the UK and the Netherlands. As a result, two potential methods are available for estimating catches or changes in fishing mortality:

1) Imputation: impute annual catches (kept and released) for England and France in 2016 by assuming the catches have changed over time to the same relative extent as Netherlands catch estimates between surveys in 2010–2011 or 2012–2013 and the survey in 2016–2017.

2) Reconstruction of change in recreational fishing mortality relative to the 2012 reference year: use the data from recreational surveys carried out by France, England, and Netherlands in 2009–2013 to calculate the reductions in retained catch in the observed trips if bag limits and increased MCRS had been implemented at the time of the surveys (Armstrong *et al*., 2014). The reductions in catch can be used to infer changes in recreational fishing mortality induced by changes in management, assuming full compliance and taking post-release mortality into account.

There are issues with both these methods. The use of imputation has a large uncertainty because: i) there are no time-series data to validate the assumption that national catches change to the same extent between years; ii) the surveys have sampling errors; and iii) the 2016–2017 Netherlands survey data are still provisional. The second method is also very uncertain due to sampling error and limitations in the survey data, assumptions concerning compliance, and dependence of results on the size of year classes present in the stock at the time of the surveys. However, the second method was considered more appropriate as it is based on observed data. As a result, the imputation approach was rejected, and estimation of the expected change in recreational F from in 2015 onwards due to change in MCRS, bag limits and closed seasons was carried out as described in Hyder *et al*. (2018).

These reductions were used, along with post-release mortality of 5%, to calculate reductions in recreational F that may have occurred in 2015, 2016 and 2017 in response to the management measures, assuming full compliance (Table 4.2.6.2.2). The differences in recreational catches used by WKBASS 2017 and 2018 are large. There are a number of factors that influenced this including: the methodology used (reconstruction rather than imputation) and lower levels of post-release mortality (5% rather than 15%). In addition, the method for inclusion of recreational catches in the assessment was different (Frec multiplier instead of simple tonnage) and the sensitivity of the model to recreational catches was assessed. The combination of these factors led to a lower recreational catch and a more appropriate approach for inclusion. This led to more robust assessment and a reduction of the Frec in the model due to the implementation of management measures.

Table 4.2.6.2.2. Values of expected recreational F reductions associated with management measures applied to Bss.27.4bc7ad–h since 2015.

	Management scenario			
Year of management measures	MCRS	Bag limit	Closed season	Recreational F relative to 2015
Pre-2015	36 cm	none	none	1.000
2015	42 cm for 0.5 year	3-fish for 0.75 year	none	0.832
2016 & 2017	42 cm	1 fish	0.5 yr	0.282
2018	42 cm	0 fish	0.5 yr	0.099

Model structure

- Temporal unit: annual based data (landings, survey indices, age frequency and length frequency).
- Spatial structure: One area.
- Sex: Both sexes combined.

Fleet definition

Six fleets defined:

1) UK bottom trawls, nets;
2) UK lines;
3) UK midwater pair trawls;
4) French fleets (combined);

5) Other (other countries and other UK fleets combined);

6) Recreational fisheries.

Landed catches

Annual landings in tonnes from 1985 to final year for the five fleets from ICES subdivisions 4.b and c, 7.a, d–h. French data were as provided by Ifremer and the recreational catch was provide for 2012 with the time-series from 1985 to present iteratively reconstructed conditioned on the 2012 estimated value. The benchmark agreed that the iterative process of estimating the missing catch would only be carried out during a benchmark or if the recreational removals deviated from the assumption of constant F over the time-series.

Discarded catches

Annual discards in tonnes were available for two fleets; UK trawls and nets and the French fleets for the period 2009 to present. Sampling of the fleets is variable across fleets and years and in some years the sampling is too low for raising discards to total catch and these are excluded from the model. Uncertainty is also included and set to 0.75 for the UK fleet and calculated uncertainty for the French fleet were available, defaulted to 0.75 if missing.

Abundance indices

Channel Groundfish Survey in 7.d in autumn (France), 1988 to 2014: total swept-area abundance index and associated length composition data. Number of stations with sea bass is used as input effective sample size. Input CV for survey = 0.30 all years. First three years of composition data are excluded.

Cefas Solent Autumn sea bass survey (7.d), years 1986 to 2009, 2011, 2013 to 2015, for ages 2–4. Selection was fitted as a function of length using a double normal model, with minimum and maximum ages specified as 2 and 4 in the age selection function.

Fishery landings age composition data: UK fleets

Age bins: 0 to 15 with a plus group for ages 16 and over. Age compositions for UK fleets are expressed as fleet-raised numbers-at-age, although they are treated as relative compositions in SS3. Year range for UK trawls/nets/lines: 1985 to present; UK midwater pair trawl: 1996 to 2015 (no samples for 1997, 2013–2014, 2016); French all fleets were input from 2000 to present.

Length composition data

The length bin was set from 4 to 100 cm by 2 cm intervals. Length compositions for fleets are expressed as fleet-raised number-at-length. Year range for UK trawls/nets:

1985 to present; UK lines: 1985 to present; UK midwater pair trawl: 1985 to 2012 (no samples for 1997, 2013–2016); French all fleets combined were input from 2000 to present. Model assumptions and parameters. The following Table C.1.1 summarises key model assumptions and parameters. See WKBASS 2017 report for detailed description of the individual datasets and basis for any recommendations for using the data in the assessment. Changes from data or parameters used in the previous WKBASS assessment in 2017 are described in the WKBASS2 2018 report.Other parameter values and input data characteristics are defined in the SS3 control file BassIVVII.ctl, the forecast file Forecast.SS and the data file BassIVVII.dat.

Table C.1.1. Key model assumptions and parameters as used for WKBASS2 2018.

Characteristic	Settings
Starting year	1985
Ending year	2016
Equilibrium catch for starting year	0.82* landings in 1985 by fleet.
Equilibrium recreational catch for starting year	*Constant F assumption*
Number of areas	1
Number of seasons	1
Number of fishing fleets	6
Number of surveys	two surveys: CGFS; Solent autumn survey
Individual growth	von Bertalanffy, parameters fixed, combined sex
Number of active parameters	86?
Population characteristics	
Maximum age	30
Genders	1
Population length bins	4–100, 2 cm bins
Ages for summary total biomass	0–30
Data characteristics	
Data length bins (for length structured fleets)	6?–94, 2 cm bins
Data age bins (for age structured fleets)	0–16+
Minimum age for growth model	2
Maximum age for growth model	30
Maturity	Logistic 2-parameter – females; L_{50} = 40.65 cm
Fishery characteristics	
Fishery timing	-1 (whole year)
Fishing mortality method	Hybrid
Maximum F	2.9
Fleet 1: UK Trawl/nets/lines selectivity	Double normal, length-based
Fleet 2: UK Line selectivity	Asymptotic, length-based
Fleet 3: UK Midwater trawl selectivity	Asymptotic, length-based
Fleet 4: Combined French fleet selectivity	Asymptotic, length-based
Fleet 5: Other fleets/gears selectivity	Asymptotic: mirrors French fleet
Fleet 6: Recreational fishery	Estimated in SS3 from survey length composition
Recreational fishing mortality vector (F(5-11)	Estimates of recreational F from 2015 onwards and PRM 5% included
Survey characteristics	
Solent autumn survey timing (yr)	0.83
CGFS survey timing (yr)	0.70
Catchabilities (all surveys)	Analytical solution
Survey selectivities: Solent autumn:	Double normal, length-based constrained by Min-Max age selectivity, age-based
Survey selectivities: CGFS	Double normal, length based
Fixed biological characteristics	

Characteristic	Settings
Natural mortality	0.24
Beverton–Holt steepness	0.999
Recruitment variability (σR)	0.9
Weight–length coefficient	0.00001296
Weight–length exponent	2.969
Maturity inflection (L_{50})	40.649 cm
Maturity slope	-0.33349
Length-at-age Amin	19.6 cm at Amin=2[1]
Length-at-Amax	80.26 cm
von Bertalanffy k	0.09699
von Bertalanffy Linf	84.55 cm
von Bertalanffy t0	-0.730 yr
Std. Deviation length-at-age (cm)	SD = 0.1166 * age + 3.5609
Age error matrix	CV 12% at-age
Other model settings	
First year for main recruitment deviations for burn-in period	1969
Last year for recruit deviations	2011
Last year no bias adjustment	1971
First year full bias adjustment	1882.5
Last year full bias adjustment	2011
First year recent year no bias adjustment	2013
Maximum bias adjustment	0.92

[1] as recommended by R. Methot after scrutinizing earlier SS3 runs during IBP-NEW 2012, and used by IBP-NEW 2012 and WGCSE 2017.

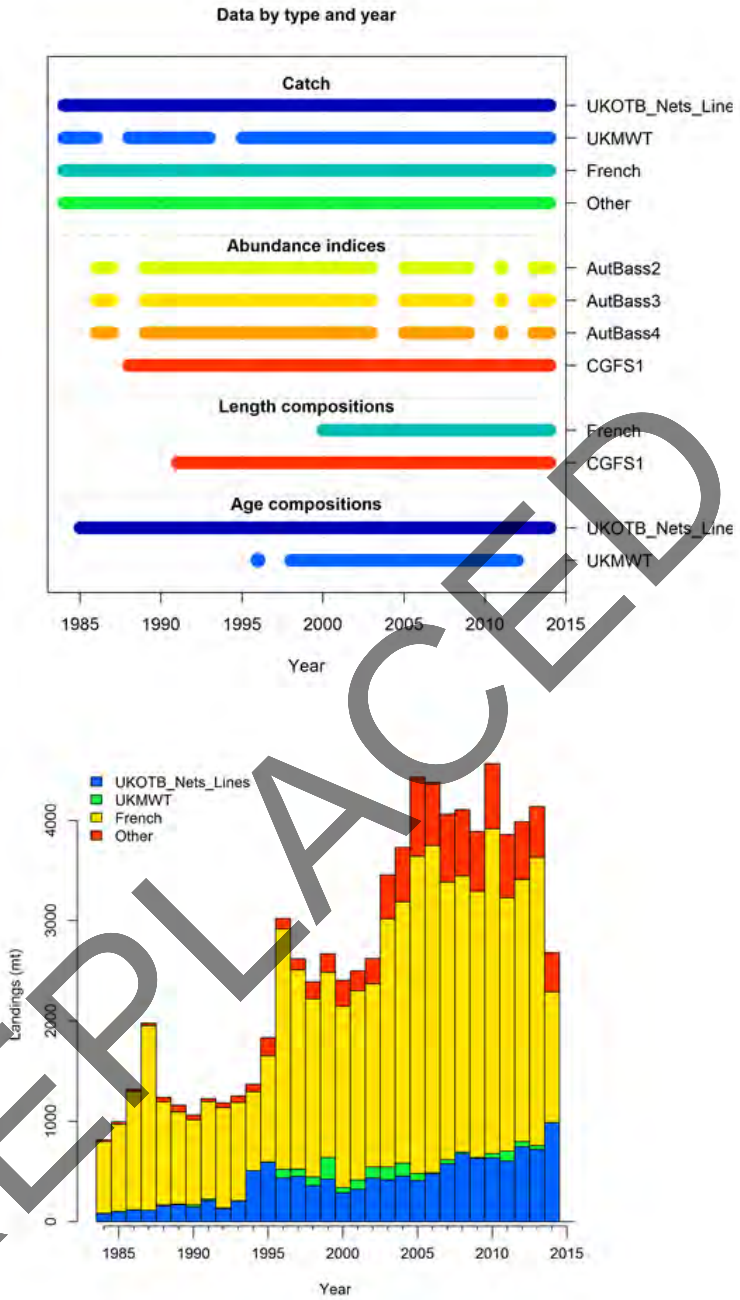


Figure C.1.1. Summary of inputs and year ranges for Stock Synthesis assessment (as at 2015).

C.2. Assessment procedure

The model is run with the executable file SS3.exe in the same folder as the following files:

BASSIVVII.CTL	SS3 CONFIGURATION FILE
BassIVVII.dat	SS3 data inputs
Starter.SS	SS3 startup file
Forecast.SS	SS3 forecast file

Results are ouput in the same folder (key results file is "results.sso"). Plots can be generated using r4ss after calling library(r4ss), using the following code (adjusted with correct path name):

```
age <- SS_output(dir= 'C:/ICES/WGCSE/Bass47/SS3 update assessment')
SS_plots(replist=age,pdf=F,png=T,dir='C:/ICES/WGCSE/Bass47/SS3update assessment')#,uncertainty=F)
```

Retrospective analysis is done with the output files from the base run in the same folder as the file retro.bat. For five retrospectives, six Starter files are included. The base file Starter.SS includes the following code nine lines from the bottom:

```
-5 # retrospective year relative to end year (e.g. -4)
```

The five retrospective Starter files use the name convention Starter-5; Starter-4; Starter-3; Starter-2; Starter-1, amending the command -5 # retrospective year relative to end year (e.g. -4) to reflect the year peel stated in the file name. A piece of code "Retro-Plots_R4SS" is available to plot the retrospectives although an Excel file is currently used to read the results from each of the Report.sso files imported into worksheets.

The recreational catch time-series was arrived at iteratively to generate a time-series of constant F with a total recreational fishery catch (landings plus dead releases) equal to 1440 t for 2012.

Future runs may need to revise this to generate the same recreational catch.

When the end year for the Stock Synthesis run is specified as the last year with fishery data, the Report.sso file contains estimates of biomass and numbers only to the start of the final year with data, and Zs only to the year before the final one. A work-around to get biomass and numbers for survivors at the end of the last year with data, and Zs for the final year with data, the end year can be specified as the year after the last with data. F values, as used by ICES, are not generated automatically by Stock Synthesis but can be computed from the Zs after subtracting M.

D. Forecast

Due to the additional complexity of adding a fixed recreational fishing mortality vector for removals (harvest), and the time required to configure Stock Synthesis to mirror the ICES procedures for short-term forecasts, IBP-BASS 2014 decided not to try to develop a forecast procedure within Stock Synthesis for use by WGCSE. This unfortunately loses the ability to provide MCMC confidence intervals around the assessment and forecasted variables, and the forecasts are entirely deterministic. Management options involving biological reference points (BRPs) adopt BRPs conditional on the assumptions in the assessment regarding M, selectivity, maturity, weights-at-age, etc. The procedures for deriving inputs for the short-term forecast are described below.

D.1. Estimating year-class abundance

Stock Synthesis does not estimate recruit deviations for years with no survey data for that year class, thus the model should be set up to estimate recruit deviations only until the last year with survey data. For example, including the Solent survey indices for ages 2–4 in 2014 means that the last year class tuned by a survey index is 2012 (two year olds in 2014). Hence, the model imputes a value from the stock–recruit curve at virgin biomass for year classes 2014 and after. SS3 will put a value from the fitted stock–

recruit curve for later year classes. WGCSE overwrites these later year classes using the long-term (1985 onwards) geometric mean, or a short-term GM if there is a persistent reduction in recent recruitment. The numbers-at-age for the starting year of the forecast are also over-written for these year classes by reducing the GM recruitment by the appropriate number of years of M (as there is very limited catch for the first few years of age). The format for reporting the recruitment values for the short-term forecast are summarised in Table D.1.1., and an example of a short-term forecast input file is given in Table D.1.2.

WGCSE 2013 reviewed some information on environmental influences on sea bass recruitment which supported a recent reduction in recruitment from 2008–2012. Survival of 0-gp and 1-gp sea bass in nursery areas in estuaries and saltmarshes is thought to be enhanced by warmer conditions promoting survival through the first two winters, and increasing the growth rates (Pawson, 1992). WGCSE 2014 presented an argument for choosing a particular recruitment value for the 2012 year class for inclusion in forecasts, based on a consideration of past recruitment in relation to temperature. Although the evidence is weak, it is not a critical assumption for short-term forecasts as these year classes have very little impact. However, the data and arguments in WGCSE 2014 should be consulted for an explanation of the logic used.

Table D.1.1. Recruitment estimates included in a short-term forecast for sea bass, from WKBASS 2018.

Year class	SS3 (age 0)	LTGM 1985–2015
2013	19 335 thousand	
2014	16 345 thousand	
2015		16 785 thousand
2016		16 785 thousand
2017		16 785 thousand

Example input for the short-term catch predictions is in Table D 1.2. The derivation of the inputs is described in Table D.1.3.

Table D.1.2. Example inputs for sea bass short-term forecast, from WKBASS 2018. Inputs for short-term forecast. F(4–15) is mean for years 2014–2016 scaled to 2016. Numbers-at-ages 0–2 in 2017 are adjusted by replacing Stock Synthesis average values in 2015–2017 (years with no recruit deviations estimated) with the short-term (2011–2014) GM in 2015 and the long-term GM in 2016 and 2017, with adjustments for natural mortality. Rules are below table.

age	No. at age in 2017	weight in stock	Proportion mature (female)	H.Cons retained mean F (2016)	H.Cons Discarded mean F (2016)	H.Cons retained mean weights	H.Cons discarded mean weights	H.Cons proportion retained	Recreation al F	Recreation al removals mean weight	M
0	**16785**	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.24
1	**13203**	0.024	0.000	0.000	0.000	0.071	0.071	0.276	0.000	0.079	0.24
2	**10384**	0.097	0.000	0.000	0.001	0.186	0.186	0.277	0.001	0.191	0.24
3	**7937**	0.210	0.000	0.002	0.005	0.348	0.348	0.319	0.003	0.341	0.24
4	**7269**	0.369	0.093	0.018	0.015	0.544	0.540	0.546	0.006	0.531	0.24
5	**1193**	0.571	0.295	0.061	0.015	0.754	0.749	0.802	0.011	0.751	0.24
6	**1750**	0.807	0.577	0.108	0.008	0.982	0.979	0.934	0.015	0.995	0.24
7	**316**	1.071	0.798	0.131	0.002	1.239	1.240	0.982	0.018	1.256	0.24
8	**898**	1.357	0.915	0.137	0.001	1.520	1.526	0.995	0.020	1.531	0.24
9	**722**	1.655	0.966	0.138	0.000	1.815	1.822	0.999	0.021	1.821	0.24
10	**757**	1.962	0.986	0.137	0.000	2.116	2.121	1.000	0.021	2.122	0.24
11	**433**	2.272	0.994	0.137	0.000	2.416	2.418	1.000	0.021	2.428	0.24
12	**234**	2.579	0.997	0.135	0.000	2.713	2.711	1.000	0.021	2.732	0.24
13	**205**	2.882	0.999	0.134	0.000	3.003	2.997	1.000	0.021	3.030	0.24
14	**163**	3.176	0.999	0.132	0.000	3.284	3.273	1.000	0.021	3.319	0.24
15	**100**	3.460	1.000	0.131	0.000	3.555	3.531	1.000	0.021	3.598	0.24
16+	119	4.176	1.000	0.129	0.000	4.193	2.034	1.000	0.021	3.864	0.24

Age 0,1,2 over-written as follows

2017 yc	2017 age 0 replaced by 1985-2014 LTGM;
2016 yc	2017 age 1 replaced by SS3 survivor estimate at age 1, 2017 * LTGM / SS3 estimate of age 0, 2016
2015 yc	2017 age 2 replaced by SS3 survivor estimate at age 2, 2017 * LTGM / SS3 estimate of age 0, 2015

Table D.1.3. Derivation of short-term forecast inputs (based on example from IBPBass 2014).

Input data	Derivation
Starting numbers-at-age 0–16+ in first year (intermediate year)	SS3 output. (N age zero overwritten where necessary by long-term GM, short-term GM or other predicition, reduced by M=0.24 for the required number of years (if no commercial catches) or multiply N at-age in starting year from the assessment by ratio of the replaced recruit value with the SS3 estimate.
Recruitment 2017 onwards	Long-term GM, short-term GM or other predictor.
Mean wt-at-age in stock	SS3 output
Proportion mature (female)	SS3 output
Commercial fishery (H-cons) mean F-at-age	Average last three years: SS3 output Zs minus M=0.24 and recreational F at-age scaled to Final year F bar if there is a trend.
Commercial fishery (H-cons) mean weight-at-age	SS3 output figures on mean weight in UK, French and other fleets, weighted by SS3 model estimates of landings numbers-at-age for the fleets.
Recreational removals F-at-age	Average last three years: SS3 output Zs minus M=0.24 and recreational F at-age scaled to Final year F bar if there is a trend.
Recreational removals weights-at-age	SS3 output figures on mean weight in UK, recreational fleet, weighted by SS3 model estimates of landings numbers-at-age for the fleet.
M	0.24 for all ages

An example detailed forecast is given in Table D.1.4 for the *status quo* F option, which is the most likely forecast given the absence of any restrictive management controls on effort or landings of sea bass. See WGCSE 2017 for examples of management options tables.

Future forecast routines may be configured in Stock Syntheses, allowing MCMC estimation of confidence limits.

Table D.1.4. Example of detailed short-term forecast (WKBASS 2018).

H.Cons Retained F mult:	1	F(4-15):	0.097	combined	0.107	Based on F	**0.0704**	
H.Cons Discarded F mult	1	F(4-15):	0.003				0.0199	0.007
Recreational F mult	0.099	F(4-15):	0.007				0.3506	

Z	Age	F(4-15): Commercial Retained	F(4-15): Commercial Discarded	F(5-11): Recreational	Catch Nos: Commercial Retained	Catch (t): Commercial Retained	Catch Nos: Commercial Discards	Catch (t): Commercial Discards	total commercial catch	Catch Nos: Recreational	Yield (t): Recreational	Stock Nos	Biomass	SSB nos. Jan 1	SSB tonnes Jan 1
0.240	0	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16393	47	0	0
0.240	1	0.000	0.000	0.000	0.1	0.0	0.3	0.0	0.0	0.6	0.0	12895	308	0	0
0.241	2	0.000	0.001	0.000	3.0	0.7	5.8	1.4	2.0	2.7	0.5	10142	978	0	0
0.248	3	0.003	0.005	0.001	5.5	2.1	9.4	3.6	5.7	1.9	0.7	2274	477	0	0
0.269	4	0.015	0.013	0.002	105.8	60.4	91.3	51.3	111.7	16.0	8.5	8315	3069	757	279
0.305	5	0.047	0.014	0.004	214.2	167.5	63.1	48.0	215.4	17.6	13.3	5291	3017	1553	886
0.339	6	0.086	0.008	0.006	73.1	72.9	6.6	6.4	79.3	4.7	4.7	1003	809	578	466
0.357	7	0.108	0.003	0.007	143.1	176.8	3.7	4.5	181.3	9.2	11.6	1582	1695	1262	1352
0.363	8	0.114	0.001	0.008	26.3	39.8	0.2	0.3	40.1	1.8	2.7	275	373	252	342
0.364	9	0.115	0.000	0.008	60.2	108.8	0.1	0.2	109.0	4.2	7.7	623	1031	601	996
0.363	10	0.115	0.000	0.008	43.7	92.3	0.0	0.1	92.3	3.1	6.6	453	888	446	875
0.363	11	0.114	0.000	0.008	45.4	109.9	0.0	0.0	110.0	3.3	7.9	473	1076	470	1069
0.362	12	0.114	0.000	0.008	24.9	67.7	0.0	0.0	67.7	1.8	4.9	261	673	260	671
0.361	13	0.113	0.000	0.008	13.1	39.4	0.0	0.0	39.4	1.0	2.9	138	399	138	398
0.360	14	0.111	0.000	0.008	11.1	36.5	0.0	0.0	36.5	0.8	2.7	118	376	118	376
0.358	15	0.110	0.000	0.008	8.4	30.0	0.0	0.0	30.0	0.6	2.3	91	313	90	313
0.357	16+	0.109	0.000	0.008	10.9	46.3	0.0	0.0	46.3	0.8	3.2	119	490	119	490
	Total				789	**1051**	180	**116**	1167	70	**80**	60447	16019	6646	8513

Year:	Intermediate year + 1	2019						
	H.Cons Retained F mult:	1	F(4-15):	0.097	combined	0.107	Based on F	**0.0704**	
	H.Cons Discarded F mult	1	F(4-15):	0.003				0.0199	0.007
	Recreational F mult	1	F(4-15):	0.007				0.3506	

Z	Age	Commercial Retained	Commercial Discarded	F(5-11): Recreational	Commercial Retained	Commercial Retained	Commercial Discards	Commercial Discards	commercial catch	Catch Nos: Recreational	Yield (t): Recreational	Stock Nos	Biomass	SSB nos. Jan 1	SSB tonnes Jan 1
0.240	0	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16393	47	0	0
0.240	1	0.000	0.000	0.000	0.1	0.0	0.3	0.0	0.0	0.6	0.0	12896	308	0	0
0.241	2	0.000	0.001	0.000	3.0	0.7	5.8	1.4	2.0	2.7	0.5	10143	978	0	0
0.248	3	0.003	0.005	0.001	19.3	7.4	32.8	12.6	19.9	6.8	2.3	7968	1670	0	0
0.269	4	0.015	0.013	0.002	22.6	12.9	19.5	10.9	23.8	3.4	1.8	1774	655	161	60
0.305	5	0.047	0.014	0.004	257.2	201.0	75.7	57.6	258.6	21.2	16.0	6352	3622	1865	1063
0.339	6	0.086	0.008	0.006	284.5	283.4	25.6	25.0	308.4	18.5	18.4	3901	3147	2248	1813
0.357	7	0.108	0.003	0.007	64.6	79.8	1.7	2.0	81.9	4.2	5.2	714	765	570	610
0.363	8	0.114	0.001	0.008	105.9	160.1	0.7	1.1	161.2	7.2	11.0	1107	1502	1013	1374
0.364	9	0.115	0.000	0.008	18.5	33.5	0.0	0.1	33.5	1.3	2.4	192	317	185	306
0.363	10	0.115	0.000	0.008	41.8	88.3	0.0	0.1	88.3	3.0	6.3	433	850	427	838
0.363	11	0.114	0.000	0.008	30.2	73.1	0.0	0.0	73.1	2.2	5.3	315	715	313	711
0.362	12	0.114	0.000	0.008	31.4	85.4	0.0	0.0	85.4	2.3	6.2	329	850	328	847
0.361	13	0.113	0.000	0.008	17.2	51.8	0.0	0.0	51.8	1.3	3.8	182	524	181	523
0.360	14	0.111	0.000	0.008	9.0	29.8	0.0	0.0	29.8	0.7	2.2	96	306	96	306
0.358	15	0.110	0.000	0.008	7.6	27.3	0.0	0.0	27.3	0.6	2.1	83	286	83	286
0.357	16+	0.109	0.000	0.008	13.4	57.0	0.0	0.0	57.0	1.0	3.9	147	602	147	602
	Total				926	1191	162	111	1302	77	87	63024	17145	7617	9340

Year:	Intermediate year + 2	2020				
	H.Cons Retained F mult:	1	F(4-15):	0.097	combined	0.107
	H.Cons Discarded F mult	1	F(4-15):	0.003		
	Recreational F mult	1	F(4-15):	0.007		

Z	Age	Commercial Retained	Commercial Discarded	F(5-11): Recreational	Commercial Retained	Commercial Retained	Commercial Discards	Commercial Discards	commercial catch	Catch Nos: Recreational	Yield (t): Recreational	Stock Nos	Biomass	SSB nos. Jan 1	SSB tonnes Jan 1
0.240	0	0.000	0.000	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16393	47	0	0
0.240	1	0.000	0.000	0.000	0.1	0.0	0.3	0.0	0.0	0.6	0.0	12896	308	0	0
0.241	2	0.000	0.001	0.000	3.0	0.7	5.8	1.4	2.0	2.7	0.5	10143	978	0	0
0.248	3	0.003	0.005	0.001	19.3	7.4	32.8	12.6	19.9	6.8	2.3	7969	1670	0	0
0.269	4	0.015	0.013	0.002	79.1	45.2	68.3	38.3	83.5	11.9	6.4	6216	2294	566	209
0.305	5	0.047	0.014	0.004	54.9	42.9	16.2	12.3	55.2	4.5	3.4	1355	773	398	227
0.339	6	0.086	0.008	0.006	341.6	340.2	30.7	30.0	370.2	22.2	22.1	4684	3779	2698	2177
0.357	7	0.108	0.003	0.007	251.2	310.5	6.5	7.9	318.4	16.2	20.3	2779	2977	2216	2374
0.363	8	0.114	0.001	0.008	47.8	72.3	0.3	0.5	72.8	3.2	5.0	500	678	457	620
0.364	9	0.115	0.000	0.008	74.5	134.6	0.1	0.3	134.9	5.2	9.5	770	1275	744	1232
0.363	10	0.115	0.000	0.008	12.8	27.2	0.0	0.0	27.2	0.9	1.9	133	261	131	258
0.363	11	0.114	0.000	0.008	28.9	69.9	0.0	0.0	69.9	2.1	5.0	301	684	299	680
0.362	12	0.114	0.000	0.008	20.9	56.8	0.0	0.0	56.8	1.5	4.1	219	565	218	563
0.361	13	0.113	0.000	0.008	21.7	65.4	0.0	0.0	65.4	1.6	4.8	229	661	229	660
0.360	14	0.111	0.000	0.008	11.9	39.1	0.0	0.0	39.1	0.9	2.9	127	402	127	402
0.358	15	0.110	0.000	0.008	6.2	22.3	0.0	0.0	22.3	0.5	1.7	67	233	67	233
0.357	16+	0.109	0.000	0.008	14.7	62.3	0.0	0.0	62.3	1.1	4.3	160	659	160	658
	Total				989	1297	161	103	1400	82	94	64941	18245	8311	10293

E. Biological reference points

E.1. Background

The Stock synthesis model used fixes stock–recruit steepness at 0.999 as there were insufficient observations at low SSB to suggest the possible steepness of the relationship. WKBASS 2018 re-evaluated the reference points using and ll analyses were conducted with EQSIM using R (© 2016 The R Foundation for Statistical Computing). SS3 model output was converted to a FLStock object in order to run EQSIM. All model and data selection setting are presented in Table E.1.1.

DATA AND PARAMETERS	SETTING	COMMENTS
SSB–recruitment data	Full dataseries (year classes 1985–2016)	
Exclusion of extreme values (option extreme.trim)	No	
Trimming of R values	Yes	-3,+3 Standard deviations
Mean weights and proportion mature; natural mortality	2007–2016	
Exploitation pattern	2015–2016	
Assessment error in the advisory year. CV of F	0.212	Set ICES default value
Autocorrelation in assessment error in the advisory year	0.423	Set ICES default value

E.2.1. Stock–recruitment relationship

The stock–recruitment plot show little dependence of R on SSB (Figure E.2.1.1). Using the stock–recruitment relationship classification proposed by ICES (2017), sea bass can be categorised as Type 5. This is a stock with no clear relationship between stock and recruitment (i.e. no apparent stock–recruitment signal).

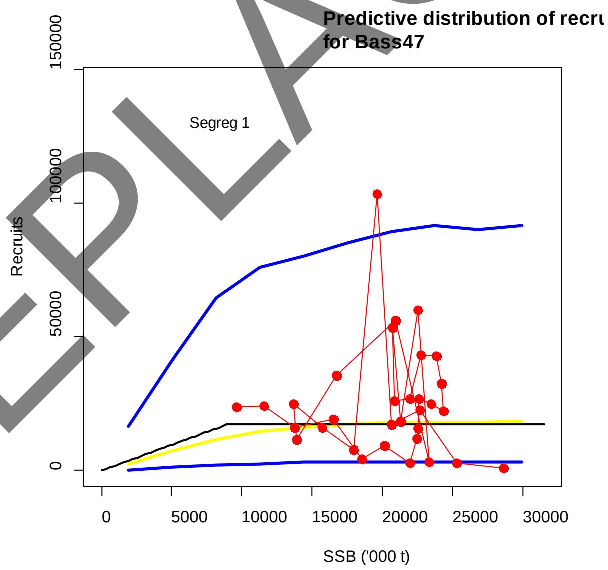


Figure E2.1.1. Stock–recruitment relationship for the sea bass in divisions 4.b–c, 7.a, and 7.d–h.

For a type 5 stock–recruitment, B_{lim} is estimated to be equal to B_{loss}. This implies a B_{lim} of 9618 tonnes, given that the model uncertainty is less than the default and not all uncertainty is accounted for, B_{pa} is therefore B_{lim} x 1.4 which is 13 465 tonnes.

E.2.2. Stock–recruitment relationship

F_{MSY} is estimated from the base run using the peak of the median landings equilibrium yield curve. The F_{MSY} range is estimated to be F values representing 95% of the peak of the median yield curve.

E.3.1. EQSIM analysis

E.3.1.1. Segmented regression method, full SR time-series, without MSY $B_{trigger}$

F_{lim} and F_{pa} were estimated using the EQSIM simulation with $B_{trigger}$ set to 0 (i.e. no $B_{trigger}$ used), F_{cv} = F_{phi} = 0 (i.e. no assessment/advice error set for this first run), and the segmented regression as the only stock–recruitment method. F_{lim} is estimated as the fishing mortality that, at equilibrium from a long-term stochastic projection, leads to a 50% probability of having SSB above B_{lim}. F_{lim} is estimated to be 0.295, and F_{pa} is estimated to be 0.211 based on the following equation [F_{pa} =F_{lim}×1.4^{-1}] as the uncertainty estimated from the model is less than the default value, so is not fully accounted.

Initially, F_{MSY} is calculated as the fishing mortality that maximises median long-term yield in stochastic simulations under constant F exploitation (i.e. without MSY $B_{trigger}$). Using the same simulation method with the inclusion of assessment/advice error, default values: F_{cv}=0.212, F_{phi}=0.423 from WKMSYREF4 (ICES, 2016). F_{MSY} = 0.214 and is thus above F_{pa} = 0.211 (Figures E.3.1.1.1 and 2), so F_{MSY} is reduced to F_{pa}.

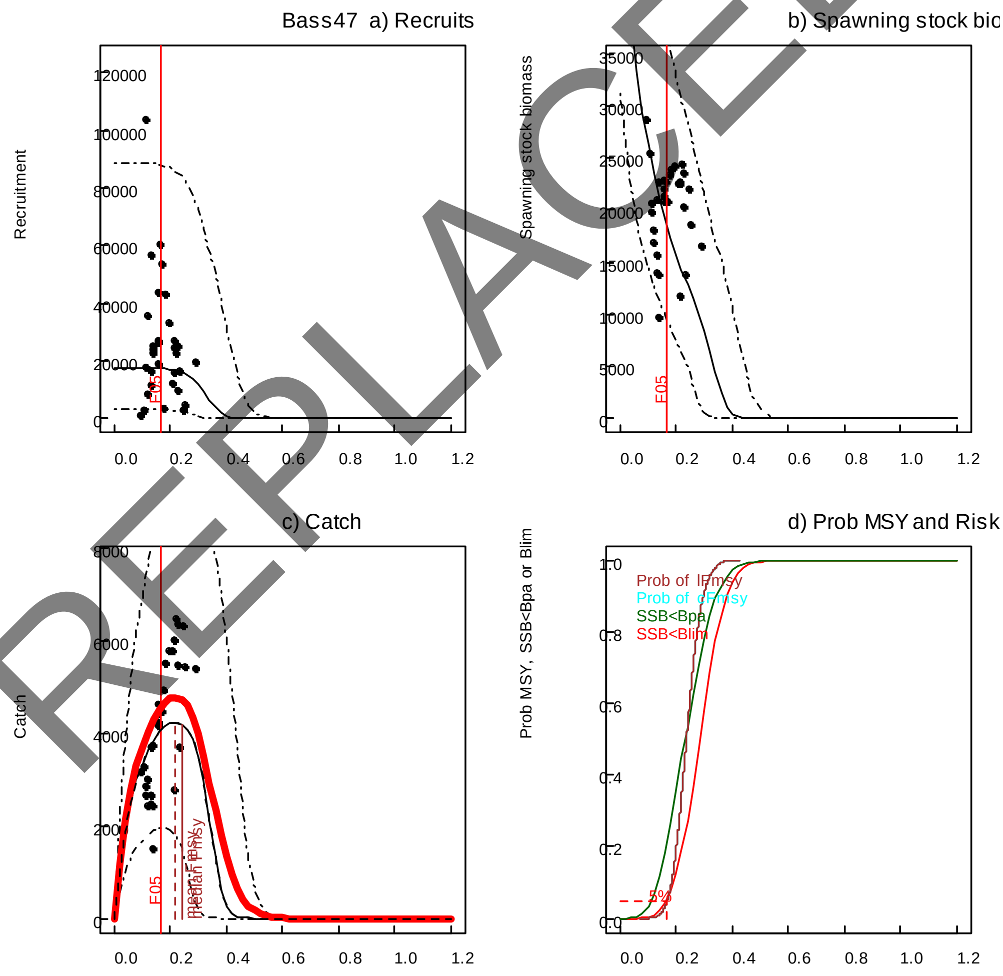


Figure E.3.1.1.1. EQSIM summary plot without $B_{trigger}$. Panels a to c: historic values (dots) median (solid black) and 90% intervals (dotted black) recruitment, SSB and landings for exploitation at fixed values of F. Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<B_{lim} (red), SSB<B_{pa} (green) and the cumulative distribution of F_{MSY} based on yield as landings (brown).

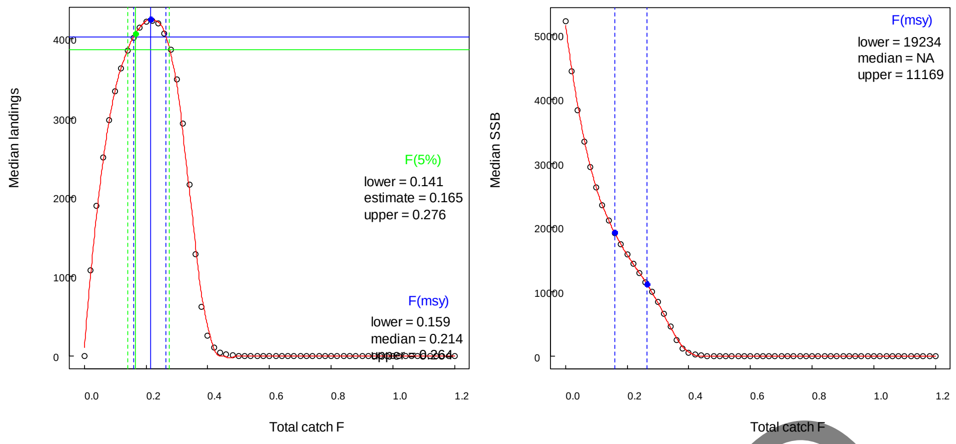


Figure E.3.1.1.2. EQSIM median landings yield curve with estimated reference points without $B_{trigger}$ (Left). Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted). Eqsim median SSB curve with estimated reference points without $B_{trigger}$ (Right). Blue dots: lower and upper SSB corresponding to lower and upper F_{MSY}.

E.3.1.2. Segmented regression method, full SR time-series, without MSY $B_{trigger}$

ICES defines MSY $B_{trigger}$ as the 5th percentile of the distribution of SSB when fishing at F_{MSY}. However if the stock has not been fished at F_{MSY}, as in this case, then MSY $B_{trigger}$ is set to B_{pa}. For the final run, assessment/advice error were included using the default values and MSY $B_{trigger}$ was set to 13,465t. EQSIM output $F_{p.05}$ (fishing mortality that gives 5% probability of SSB below B_{lim}) is 0.203. As F_{MSY} estimated in the first run is above $F_{p.05}$, then F_{MSY} is further reduced to $F_{p.05}$, 0.203 (0.141–0.203).

E.3.1.3. Proposed reference points

The proposed reference points (Table E.3.1.3.1) are displayed on the diagnostic plots of the final assessment (Figure E.3.1.3.1).

Table E.3.1.3.1. Summary table of proposed reference points derived using EQSIM.

STOCK	Seabass divisions 4.b–c, 7.a, and 7.d–h		
PA Reference points	Value	Rational	
B_{lim}	9 618 t	Lowest observed SSB (Type 5 S-R relationship)	
B_{pa}	13 465 t	B_{lim} × 1.4	
F_{lim}	0.295	In equilibrium gives a 50% probability of SSB>B_{lim}	
F_{pa}	0.211	$F_{pa} = F_{lim} / 1.4$	
MSY Reference point			
F_{MSY}	0.203	Reduce from 0.214 as F_{MSY}>F_{PA}>$F_{P.05}$	With WKMSYREF4 default values for assessment &
F_{MSY} lower	0.141	Changed from 0.159 as $F_{MSY} > F_{P.05}$	
F_{MSY} upper	0.203	Reduced from 0.263 as $F_{MSY} > F_{P.05}$	
MSY $B_{trigger}$	13 465 t		

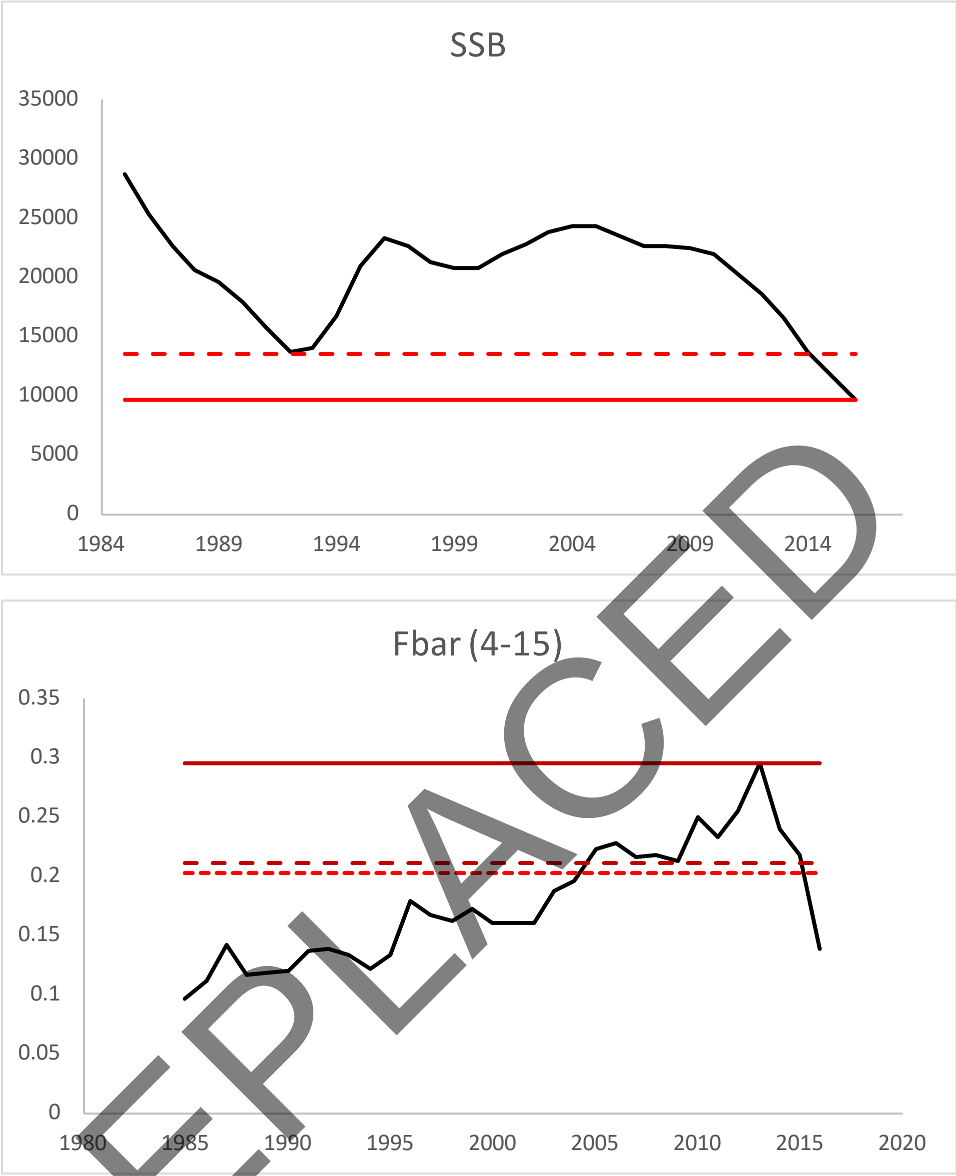


Figure E.3.1.3.1. Diagnostic plots of the final sea bass in divisions 4.b–c, 7.a, and 7.d–h assessment with proposed reference points (B_{lim}, B_{pa}, MSY $B_{trigger}$, F_{lim}, F_{pa}, F_{MSY}): SSB and F_{bar} (computed from ages 4–15) time-series.

F. Other issues

F.1. Historical overview of previous assessment methods

Previous assessments of sea bass in the 4 and 7 area are summarised below.

2007: Pawson *et al*. 2007. ADMB separable model on UK data; updated 2008 at WGNEW (Kupschus *et al*., 2008).

2012: IBP-NEW.. Development of age and length based Stock Synthesis assessment.

2013: WGCSE. Update assessment using IBP-NEW SS model. Recommended inter-benchmark to improve model.

2014: IBP-BASS. Added new CGFS surveys series; removed poorly performing surveys; improved fleet structure and selectivity model; incorporated recreational fishery information; developed forecast and BRPs.

2014, 2015: WGCSE. Update assessment using IBP-BASS model.

2016: IBP-BASS2. SS3 model with adjustments and update assessment.

2016: WGCSE. Update assessment using IBP-BASS2 model

2017: WKBASS1. SS3 model with adjustments to account for changes in selectivity of French fleet and update assessment.

2017: WGCSE. Update assessment using IBP-BASS2 model

2018: WKBASS2. Update assessment and estimation of BRPs with EQsim software.

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Appendix 1

Content of Stock Synthesis Control File (BassIVVII.ctl) used at WKBass 2018. Rows preceded by # are skipped, and are greyed out.

```
# C Sea bass IV VII input data file
# _SS-V3.24u
# benchmark 2017-18
#  ------------------------
#  ------------------------
1                                  #_N_Growth_Patterns
1                                  #_N_Morphs_Within_GrowthPattern(GP)
#_Cond 1        #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond 1        #vector_Morphdist_(-1_in_first_val_gives_normal_approx)
#
##1      #  N recruitment designs goes here if N_GP*nseas*area>1 #here 1 gp, 4 seasons, 1 area
##0      #  placeholder for recruitment interaction request
#GP seas area for each recruitment assignment
##1 1 1    # example recruitment design element for GP=1, season=1, area=1
#
#_Cond 0 # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10
#
#  ------------------------
1 #_Nblock_Patterns
1 #_blocks_per_pattern
2015 2016 # begin and end years of blocks in first pattern
#
#  ------------------------
0.5 #_fracfemale #? Note sex ratio in bass increases with length.
0  #_natM_type:_0=1Parm;  1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#0.150  0.150  0.150  0.152  0.163  0.209  0.247  0.256  0.257  0.257
        0.257  0.257  0.257  0.257  0.257  0.257  0.257  0.257  0.257
        0.257  0.257  0.257  0.257  0.257  0.257  0.257  0.257  0.257
        0.257  0.257  0.257
#  ------------------------
```

1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented #note - maguire *et al* 2008 pg 1270, Downloaded from icesjms.oxfordjournals.org at ICES on October 17, 2011

2 #_Growth_Age_for_L1

28 #_Growth_Age_for_L2 (999 to use as Linf)

0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)

3 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)

1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=read fec and wt from wtatage.ss

#_placeholder for empirical age-maturity by growth pattern

----

4 #_First_Mature_Age

1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b

0 #_hermaphroditism option: 0=none; 1=age-specific fxn

1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)

1 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound check)

#_growth_parms

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

#_growth_parms

0.01 0.5 0.24 0.24 -1 0.1 -3 0 0 0 0 0 0 0 # NatM_p_1_GP_1 #Has a Vestor of Mortality to include the Rec fishing component.

-1 30 19.67 19.67 -1 0.5 -5 0 0 0 0 0 0 0 # L_at_Amin_GP_1

60 100 80.26 80.26 -1 15 -4 0 0 0 0 0 0 0 # L_at_Amax_GP_1

0.01 0.2 0.09699 0.09699 -1 0.05 -3 0 0 0 0 0 0 0 # VonBert_K_GP_1

2 6 3.9 3.9 -1 0.8 6 0 0 0 0 0 0 0 # CV_young_GP_1

4 10 6.9 6.9 -1 0.8 6 0 0 0 0 0 0 0 # CV_old_GP_1

weight-length relationship

-1 1 0.00001296 0.00001296 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_1

2 4 2.969 2.969 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_2

proportion mature at length

30 50 40.649 40.649 -1 5 -3 0 0 0 0 0 0 0 # Mat50%

-5 1 -0.33349 -0.33349 -1 0.03764 -3 0 0 0 0 0 0 0 # Mat_slope

fecundity option 1, parm values from dissertation (units of millions of eggs per kg)

-3 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_inter

-3 3 0 0 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_slope_wt

recruitment apportionment

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_GP_1

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_Area_1

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_Seas_1

cohort growth deviation (fix value at 1 with negative phase; needed for blocks or annual devs)

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # CohortGrowDev

#

#_Cond 0 #custom_MG-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

#

#_Cond 0 #custom_MG-block_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters

#_Cond No MG parm trends

#

#_seasonal_effects_on_biology_parms

0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,L1,K

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters

#

#-6 #_MGparm_Dev_Phase

#

#_Spawner-Recruitment

3 #_SR_function

#_LO HI INIT PRIOR PR_type SD PHASE

1 16 10 5 -1 1 1 # SR_R0

0.2 0.999 0.999 0.999 -1 0.2 -1 # SR_steep

0.1 2 0.9 0.9 -1 0.2 -5 # SR_sigmaR

-5 5 0 0 -1 1 -3 # SR_envlink

-5 5 0 -0.7 -1 2 -2 # SR_R1_offset

0 0 0 0 -1 0 -99 # SR_autocorr

0 #_SR_env_link

0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 #do_recdev: 0=none; 1=devvector; 2=simple deviations

1955 # first year of main recr_devs; early devs can preceed this era

2014 # last year of main recr_devs; Final data yr-2.

3 #_recdev phase

1 # (0/1) to read 13 advanced options

0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)

-4 #_recdev_early_phase

0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)

1 #_lambda for prior_fore_recr occurring before endyr+1

1974.5 #_last_early_yr_nobias_adj_in_MPD

1981.7 #_first_yr_fullbias_adj_in_MPD

2013.9 #_last_yr_fullbias_adj_in_MPD 2012

2014.8 #_first_recent_yr_nobias_adj_in_MPD 2013

0.907 #_max_bias_adj_in_MPD (1.0 to mimic pre-2009 models)

0 #_period of cycles in recruitment (N parms read below)

-5 #min rec_dev

5 #max rec_dev

0 # 3 #_read_recdevs

#_end of advanced SR options

#

#Fishing Mortality info

0.2 # F ballpark for tuning early phases

-2001 # F ballpark year (neg value to disable)

3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)

2.9 # max F or harvest rate, depends on F_Method

no additional F input needed for Fmethod 1

if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read

#0.3 3 0 # if Fmethod=3; read N iterations for tuning for Fmethod 3

5 # N iterations for tuning F in hybrid method (recommend 3 to 7)

#

#_initial_F_parms

#_LO HI INIT PRIOR PR_type SD PHASE

0 2 0.03 0.03 -1 0.5 1 # InitF_OTB_Nets

0 2 0.03 0.03 -1 0.5 1 # InitF_Lines

0 2 0.03 0.03 -1 0.5 1 # InitF_Midwater

0 2 0.03 0.03 -1 0.5 1 # InitF_French

0 2 0.03 0.03 -1 0.5 1 # InitF_Other

0 2 0.03 0.03 -1 0.5 1 # InitF_RecFish

#

Catchability Specification (Q_setup)

A=do power: 0=skip, survey is prop. to abundance, 1= add par for non-linearity

B=env. link: 0=skip, 1= add par for env. effect on Q

C=extra SD: 0=skip, 1= add par. for additive constant to input SE (in ln space)

D=type: <0=mirror lower abs(#) fleet, 0=no par Q is median unbiased, 1=no par Q is mean unbiased, 2=estimate par for ln(Q)

3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of devs about Q for indexyr-1

0 0 0 0 # FISHERY1

0 0 0 0 # FISHERY2

0 0 0 0 # FISHERY3

0 0 0 0 # FISHERY4

0 0 0 0 # FISHERY5

0 0 0 0 # Fishery6

0 0 1 0 # SURVEY AutBass

0 0 1 0 # Survey CGFS1

0 0 1 0 # FR_LPUE

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index

#_Q_parms(if_any)

LO HI INIT PRIOR PR_type SD PHASE

0 1 0.1 0.1 -1 99 3 # Q_extraSD_AutBass

0 1 0.1 0.1 -1 99 3 # Q_extraSD_CGFS1

0 1 0.1 0.1 -1 99 3 # Q_extraSD_LPUE

#

#_size_selex_types

24 1 0 0 # 1 UKTrawl_Nets #_RDM now all fleets have size selectivity

1 0 0 0 # 2 UKLines

1 0 0 0 # 3 UKMidwater

24 1 0 0 # 4 French

15 0 0 4 # 5 Other

24 0 0 0 # 6 RecFish

24 0 0 0 # 7 AutBass

24 0 0 0 # 8 CGFS1

15 0 0 4 # 9 FR_LPUE

#

#_age_selex_types

#_Pattern ___ Male Special

10 0 0 0 # 1 UKTrawl_Nets

10 0 0 0 # 2 UKLines

10 0 0 0 # 3 UKMidwater

10 0 0 0 # 4 French

15 0 0 4 # 5 Other

10 0 0 0 # 6 RecFish

11 0 0 0 # 7 AutBass

10 0 0 0 # 8 CGFS1

15 0 0 4 # 9 FR_LPUE

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

#UK Trawl_Nets

20 93 45 45 -1 0.05 2 0 0 0 0 0 1 2 # SizeSel_2P_1_OTB # PEAK

-15 4.0 -15 -15 -1 0.05 -3 0 0 0 0 0 1 2 # SizeSel_2P_2_OTB # TOP

-1 9.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 1 2 # SizeSel_2P_3_OTB # ASC-WIDTH

-1 9.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_4_OTB # DSC-WIDTH

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_OTB # INIT

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_OTB # FINAL

#UK Trawl_Nets_retention

20 50 36 36 -1 0.05 4 0 0 0 0 0 1 2 # retention_1p_OTB # Inflection

0.61 10.01 0.81 0.81 -1 0.05 4 0 0 0 0 0 1 2 # retention_2P_OTB# Slope

0 1 1 1 -1 0.05 -3 0 0 0 0 0 0 0 # retention_2P_OTB # Asymptotic retention

0 0 0 0 -1 0.05 -3 0 0 0 0 0 0 0 # retention_2P_OTB # Male offset To inflection

#UK Lines

20 91 39 30 -1 0.05 2 0 0 0 0 0 1 2 # SizeSel_5P_1_Lines

0.01 30 2 5 -1 0.05 3 0 0 0 0 0 1 2 # SizeSel_5P_2_Lines

#UK midwater

20 91 39 30 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_5P_1_MWT

0.01 30 2 5 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_5P_2_MWT

#French

20 91 57 57 -1 0.05 2 0 0 0 0 0 1 2 # SizeSel_1P_1_French # PEAK

-15 4.0 -15 -15 -1 0.05 -3 0 0 0 0 0 1 2 # SizeSel_1P_1_French # TOP

-1.0 9.0 6 6 -1 0.05 3 0 0 0 0 0 1 2 # SizeSel_1P_1_French # ASC-WIDTH

-1.0 9.0 9.0 9.0 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_1P_1_French # DSC-WIDTH

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_1P_1_French # INIT

-999 9.0 9 -999 -1 0.05 -2 0 0 0 0 0 1 2 # SizeSel_1P_1_French # FINAL

Freanch retention

30 50 36 36 -1 0.05 4 0 0 0 0 0 1 2 # retention_1p_French # Inflection

0.61 10.01 0.81 0.81 -1 0.05 4 0 0 0 0 0 1 2 # retention_2P_French # Slope

0 1 1 1 -1 0.05 -3 0 0 0 0 0 0 0 # retention_2P_French # Asymptotic retention

0 0 0 0 -1 0.05 -3 0 0 0 0 0 0 0 # retention_2P_French # Male offset To inflection

#Rec

20 93 45 45 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_RecFish # PEAK

-15 4.0 -15 -15 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_1_RecFish # TOP

-1 9.0 5 5 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_3_RecFish # ASC-WIDTH

-1 9.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_4_RecFish # DSC-WIDTH

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_RecFish # INIT

-999 9.0 9 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_RecFish # FINAL

#Autbass

19 93 32 32 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_AutBass # PEAK

-15 4.0 -15 -6.0 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_1_AutBass # TOP

-1.0 9.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_3_AutBass # ASC-WIDTH

-1.0 9.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_4_AutBass # DSC-WIDTH

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_RecFish # INIT

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_RecFish # FINAL

#CGFS1

20 93 32 32 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_CGFS1 # PEAK

-15 4.0 -15 -15 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_2_CGFS1 # TOP

-1.0 9.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_3_CGFS1 # ASC-WIDTH

-1.0 9.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_4_CGFS1 # DSC-WIDTH

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_CGFS1 # INIT

-999 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_CGFS1 # FINAL

2 2 2 2 -1 99 -3 0 0 0 0 0 0 0 # AgeSel_10P_1_Autumn 2 min age

4 4 4 4 -1 99 -3 0 0 0 0 0 0 0 # AgeSel_10P_2_Autumn 4 max age

#_Cond 0 #_custom_sel-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns

1 #_custom_sel-blk_setup (0/1)

Lo Hi Init Prior P_type SD Phase

##UK trawl selx

20 93 45 45 -1 0.05 2 # UK_Trawl_Net # PEAK

-15 4.0 -15 -15 -1 0.05 3 # UK_Trawl_Net # Top

-1 9.0 3.3 3.3 -1 0.05 3 # UK_Trawl_Net # ASC-WIDTH

20 50 36 36 -1 0.05 4 # UK_Trawl_Net # retention inflection

0.61 10.01 0.81 0.81 -1 0.05 4 # UK_Trawl_Net # Slope

20 91 39 30 -1 0.05 2 # UK_lines #

0.01 30 2 5 -1 0.05 3 # UK_lines #

20 91 57 57 -1 0.05 2 # French # PEAK

-15 4.0 -15 -15 -1 0.05 3 # UK_Trawl_Net # Top

-1.0 9.0 6 6 -1 0.05 3 # French # ASC=WIDTH

-999 9.0 -999 -999 -1 0.05 -2 # French # Final

30 50 36 36 -1 0.05 4 # French # retention inflection

0.61 10.01 0.81 0.81 -1 0.05 4 # French # Slope

#_Cond No selex parm trends

#_Cond -4 # placeholder for selparm_Dev_Phase

1 #_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)

#

Tag loss and Tag reporting parameters go next

0 # TG_custom: 0=no read; 1=read if tags exist

#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters

#

1 #_Variance_adjustments_to_input_values

#_fleet/svy: 1 2 3 4 5 6 7 8 9

0 0 0 0 0 0 0 0 0 #_add_to_survey_CV

0 0 0 0 0 0 0 0 0 #_add_to_discard_stddev

0 0 0 0 0 0 0 0 0 #_add_to_bodywt_CV

0.11862964 0.167812466 0.160225005 0.11531102 1 1 1 0.342898372 1 #_mult_by_lencomp_N

0.210073726 0.151254911 0.649190911 0.258469753 1 1 0.979453085 1 1 #_mult_by_agecomp_N

1 1 1 1 1 1 1 1 1 #_mult_by_size-at-age_N

#

3 #_maxlambdaphase

1 #_sd_offset

#

8 # number of changes to make to default Lambdas (default value is 1.0)

Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;

9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin

#like_comp fleet/survey phase value sizefreq_method

4 1 1 0.5 1 #_RDM reduce emphasis on age and length comp by 50%

4 2 1 0.5 1

4 3 1 0.5 1

4 4 1 0.5 1

5 1 1 0.5 1

5 2 1 0.5 1

5 3 1 0.5 1

5 4 1 0.5 1

#

0 # (0/1) read specs for more stddev reporting

1 1 -1 5 1 5 1 -1 5 # selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages

5 15 25 35 43 # vector with selex std bin picks (-1 in first bin to self-generate)

1 2 14 26 40 # vector with growth std bin picks (-1 in first bin to self-generate)

1 2 14 26 40 # vector with NatAge std bin picks (-1 in first bin to self-generate)

999

Appendix 2

Content of Stock Synthesis Data file (BassIVVII.dat) used at WKBASS 2018. The file was originally built from one used for other species, and some comments remain that are for those assessments. Rows preceded by # are skipped, and are greyed out.

C Sea bass IV VII input data file

benchmark WKBass 2018

1985 # _styr

2016 # _endyr

1 # _nseasons lr number of quarters in a year

12 # _nmonths per season

1 # _spawn_seas

6 # _Nfleet

3 # _Nsurveys

1 # _N_areas

FLEET/SURVEY NAMES, TIMING, ETC.

Fishery & survey names separated by "%"

UKOTB_Nets%Lines%UKMWT%French%Other%RecFish%AutBass%CGFS1%FR_LPUE

-1 -1 -1 -1 -1 -1 0.83 0.75 -1 # _surveytiming_in_season

1 1 1 1 1 1 1 1 1 # _area_assignments_for_each_fishery_and_survey

1 1 1 1 1 1 # _units of catch: 1=bio; 2=num

0.1 0.1 0.1 0.1 0.1 0.1 # _se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3

1 #_Ngenders

30 #_Nages

57.5 24.4 0.51 713.7 18.7 2125 # _init_equil_catch_for_each_fishery (1985 landings * 0.82 see IBPNEW2012)

32 # _N_lines_of_catch_to_read

Retained catch in biomass (metric tonnes (mt))

--

includes RETAINED ONLY

--

#UKOTB_Nets	Lines	UKMWT	French	Other	RecFish	Year	Season
70	30	1	870	23	2148	1985	1
84	33	2	1180	19	1933	1986	1
96	18	0	1840	25	1753	1987	1
129	30	8	1028	44	1616	1988	1
141	29	7	917	67	1490	1989	1
128	18	22	849	47	1342	1990	1
152	60	14	971	29	1224	1991	1
105	23	8	1001	49	1222	1992	1
146	62	1	979	68	1383	1993	1
354	154	0	786	76	1640	1994	1
424	169	4	1057	181	1848	1995	1
308	128	87	2395	104	1890	1996	1
335	119	71	1984	111	1819	1997	1
241	121	85	1773	170	1766	1998	1
274	148	220	1843	185	1765	1999	1
236	53	52	1805	261	1816	2000	1
263	58	97	1883	199	1898	2001	1
361	75	110	1825	251	1980	2002	1
353	65	127	2471	443	2035	2003	1
380	72	131	2604	544	2048	2004	1
353	59	68	3161	789	2014	2005	1
359	119	11	3259	629	1955	2006	1
413	166	37	2771	677	1922	2007	1
514	163	17	2750	663	1902	2008	1
486	147	9	2649	598	1859	2009	1
452	183	42	3236	649	1751	2010	1
462	143	98	2526	629	1604	2011	1
564	185	49	2610	579	1440	2012	1
530	191	39	2871	506	1227	2013	1
751	236	1	1303	391	1020	2014	1
440	199	0	1110	317	703	2015	1
305	210	2	547	231	212	2016	1

--

70 #_N_cpue_and_surveyabundance_observations

#_Units: 0=numbers; 1=biomass; 2=F

#_Errtype: -1=normal; 0=lognormal; >0=T

#_Fleet Units Errtype

1	1	0	#	UK OTB_Nets
2	1	0	#	UK Lines
3	1	0	#	UK MWT
4	1	0	#	French fleets
5	1	0	#	Other
6	1	0	#	RecFish
7	0	0	#	AutBass
8	0	0	#	CGFS1
9	1	0	#	FR_LPUE

################################

yr qtr indexNumber(5-6) indexResult indexSE

AutBass (numbers for ages 2-4):

1986	1	7	5.84	0.433295234
1987	1	7	2.6	0.433295234
1989	1	7	7.05	0.433295234
1990	1	7	3.98	0.433295234
1991	1	7	3.32	0.433295234
1992	1	7	19.7	0.433295234
1993	1	7	14.63	0.433295234
1994	1	7	5.46	0.433295234
1995	1	7	10.24	0.433295234
1996	1	7	6.06	0.433295234
1997	1	7	38.2	0.433295234
1998	1	7	7.34	0.433295234
1999	1	7	20.91	0.433295234
2000	1	7	17.46	0.433295234
2001	1	7	39.91	0.433295234
2002	1	7	11.7	0.433295234
2003	1	7	13.55	0.433295234
2005	1	7	21.93	0.433295234
2006	1	7	19.73	0.433295234
2007	1	7	5.5	0.433295234
2008	1	7	25.52	0.433295234
2009	1	7	19.83	0.433295234
2011	1	7	4.06	0.433295234
2013	1	7	1.52	0.433295234

2014	1	7	1.4	0.433295234
2015	1	7	7.44	0.433295234
2016	1	7	6.03	0.433295234
##	CGFS1:			
1988	1	8	245776	0.6
1989	1	8	77716	0.6
1990	1	8	1129914	0.6
1991	1	8	4250635	0.3
1992	1	8	2617984	0.3
1993	1	8	2299918	0.3
1994	1	8	1097829	0.3
1995	1	8	1021740	0.3
1996	1	8	1224238	0.3
1997	1	8	1817599	0.3
1998	1	8	2531044	0.3
1999	1	8	1642270	0.3
2000	1	8	2570996	0.3
2001	1	8	3150674	0.3
2002	1	8	3872427	0.3
2003	1	8	8739057	0.3
2004	1	8	3598440	0.3
2005	1	8	3005317	0.3
2006	1	8	5517999	0.3
2007	1	8	3661314	0.3
2008	1	8	6468841	0.3
2009	1	8	2564696	0.3
2010	1	8	1804537	0.3
2011	1	8	1513745	0.3
2012	1	8	2034554	0.3
2013	1	8	995987	0.3
2014	1	8	669931	0.3
##	FRLPUE:			
2001	1	9	1.17	0.0578
2002	1	9	1.194	0.047
2003	1	9	1.181	0.0536
2004	1	9	1.158	0.0407
2005	1	9	1.153	0.0434

2006	1	9	1.158	0.05
2007	1	9	1.254	0.0513
2008	1	9	1.303	0.0414
2009	1	9	1	0
2010	1	9	0.919	0.048
2011	1	9	0.787	0.055
2012	1	9	0.813	0.062
2013	1	9	0.739	0.052
2014	1	9	0.642	0.047
2015	1	9	0.595	0.05
2016	1	9	0.52	0.044

DISCARDED CATCH

----

2 # _N_fleets_with_discard

1	1	-2
4	1	-2

23 # N discard obs

#

2002	1	1	17	0.75
2003	1	1	16	0.75
2004	1	1	59	0.75
2005	1	1	96	0.75
2006	1	1	53	0.75
2007	1	1	50	0.75
2008	1	1	8	0.75
2009	1	1	86	0.75
2010	1	1	50	0.75
2011	1	1	22	0.75
2012	1	1	29	0.75
2013	1	1	5	0.75
2014	1	1	7	0.75
2015	1	1	7	0.75
2016	1	1	43	0.75

2017	1	1	0.202	0.75
2009	1	4	65.2	0.619
2010	1	4	97.9	0.638
2012	1	4	127.6	0.185
2013	1	4	48.4	1.136
2014	1	4	17.7	0.835
2015	1	4	32.5	0.79
2016	1	4	152.7	0.75

MEAN BODY WEIGHT

----

0 # _N_meanbodywt_obs

30 #_DF_for_meanbodywt_T-distribution_like

LENGTH COMPOSITION SET-UP

----

population length bins (not necessarily same as data bins, below)

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector

2 # number of population length bins to be read

4

94

-0.001 #_comp_tail_compression

1e-007 #_add_to_comp

0 #_combine males into females at or below this bin number

LENGTH COMPOSITION DATA

----

45 #_N_LengthBins

vector of length N_LengthBins with lower edges of each bin

6	8	10	12	14	16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66
	68	70	72	74	76	78	80	82	84	86
	88	90	92	94						

153 #_N_Length_obs

#Yr Season Flt/Svy Gender Part Nsamp datavector(female-male)

LANDINGS OF COMMERCIAL FLEETS (1 TO 5), ORDERED BY YEAR AND QUARTER:

1985	1	1	0	2	34	0	0	0	0	0
	0	65	0	0	130	0	185	2154	9307	
	17771	11520	7353	6195	3248	4184	4005	4135	3269	1254
	1171	1641	1224	1180	584	234	414	94	152	445
	152	0	67	0	0	0	0	0	0	0
	0									
1986	1	1	0	2	52	0	0	0	0	0
	0	0	0	0	0	8881	6175	1522	7181	8854
	4903	9250	8551	5295	4432	3045	2208	3867	2638	1567
	1380	2851	995	1375	352	90	5036	311	1794	4
	216	109	2	0	0	0	0	0	0	0
1987	1	1	0	2	113	0	0	0	0	0
	0	0	0	0	188	0	0	5148	20706	
	17049	22638	11144	13791	5629	5008	2384	2475	1252	1681
	1460	1001	913	2667	2945	713	2229	194	761	381
	660	191	0	0	179	0	0	0	0	0
	0									
1988	1	1	0	2	73	0	0	0	0	16
	16	0	0	0	32	761	1431	7219	6402	
	12495	35742	14723	11915	12763	17220	6430	4406	1698	2566
	1639	918	2439	1888	153	1194	822	1964	515	743
	552	210	172	177	33	20	0	0	0	0
	0									
1989	1	1	0	2	94	0	0	0	0	0
	0	0	0	0	0	0	0	10076	7434	
	16034	20457	12060	11120	15380	11197	11691	8578	6183	3381
	3457	2999	2588	2852	2309	1579	1472	1344	427	540
	56	41	56	64	0	0	0	0	0	0
	0									
1990	1	1	0	2	63	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	231
	6223	6914	8672	4714	9034	16220	7610	9973	7415	5356
	3246	1226	2895	1784	1441	1099	565	346	158	304
	124	0	98	148	0	566	0	0	0	0
1991	1	1	0	2	67	0	0	0	0	0
	0	0	0	0	0	0	0	60	179	7350
	23199	11237	6005	4235	4202	4461	5509	5105	5275	5129
	7434	3315	5836	2703	729	2551	2614	3546	727	84
	1379	202	4	260	0	0	0	0	0	0
1992	1	1	0	2	53	0	0	0	0	0
	0	0	0	0	0	0	0	0	202	
	10251	34088	28604	14364	11787	4507	2927	1668	4105	1574
	2119	1510	1313	1072	953	363	340	245	257	1502
	604	0	0	75	54	0	0	0	0	0
	0									

1993	1	1	0	2	163	0	0	0	0	0
	0	0	0	0	0	0	22	3824	899	9580
	63497	38604	24428	12330	8183	4533	4499	2704	1619	1925
	1808	2365	1700	1273	547	1136	448	331	395	419
	845	64	23	0	189	0	0	0	0	0
1994	1	1	0	2	301	0	0	0	0	0
	0	0	0	0	0	41	294	3134	13855	
	24439	129505	123864	80678	40573	17235	9901	7294	4994	3368
	2752	2401	2438	2518	2146	1616	1584	1156	1246	931
	354	300	303	296	201	196	0	0	196	0
	0									
1995	1	1	0	2	244	0	0	0	0	0
	0	0	0	0	0	0	0	18	1789	
	16942	92179	102900	94279	70417	47122	23608	19100	5219	4526
	5666	1680	1067	1828	3109	1553	1670	3025	756	919
	322	158	0	61	0	0	0	0	0	0
	0									
1996	1	1	0	2	182	0	0	0	0	0
	0	0	0	0	0	0	0	0	381	6026
	41792	52179	69395	65619	42281	25995	9847	5172	4918	7792
	1453	2656	2956	677	590	800	618	765	169	1402
	520	96	96	0	10	0	0	0	0	0
1997	1	1	0	2	178	0	0	0	0	0
	0	0	0	0	0	0	0	0	13	2701
	24764	39040	40706	42434	40369	39013	34893	20836	13939	8078
	5869	2309	2564	825	601	1231	2317	1583	849	73
	516	68	0	29	6	0	0	0	0	0
1998	1	1	0	2	129	0	0	0	0	0
	0	0	0	0	0	0	0	523	1819	
	11497	31816	36175	37154	31132	24428	23014	15281	13728	8376
	5485	4375	2326	1545	962	927	284	445	527	193
	102	13	0	0	0	24	0	0	0	0
	0									
1999	1	1	0	2	128	0	0	0	0	0
	0	0	0	77	38	0	38	77	426	
	14262	61905	70065	61131	44444	26605	15904	10526	8488	5975
	5417	3118	2648	1680	1630	520	389	289	278	123
	225	91	0	38	0	0	47	0	0	0
	0									
2000	1	1	0	2	153	0	0	0	0	0
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	48896	64332	53940	33900	22938	15274	6262	8145	5403	4637
	3391	2036	1356	1179	252	475	368	84	38	84
	133	386	32	0	0	16	0	0	0	0
2001	1	1	0	2	162	0	0	0	0	0
	0	0	0	0	25	19	39	19	2288	
	15716	64089	52490	49167	37384	17952	14200	7642	8485	5841
	7872	3872	3937	3812	3380	1995	1560	786	161	34
	66	775	3	30	25	0	0	0	0	0
	0									
2002	1	1	0	2	310	0	0	0	0	0
	98	16	0	49	65	16	325	446	893	
	31390	85336	93085	69271	40986	29133	19327	15215	10706	7096

	7106	5447	3998	2393	2191	1579	1080	1665	625	59
	87	159	40	49	0	0	0	0	0	0
	0									
2003	1	1	0	2	285	0	0	0	0	0
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	57062	77986	70341	43681	29493	20640	18412	15623	11819	7903
	6477	3672	2989	1869	2803	1021	723	294	1397	197
	193	348	0	0	118	0	0	0	0	0
2004	1	1	0	2	186	0	0	0	0	0
	0	0	0	0	0	0	0	30	477	7112
	56436	77855	88743	75236	57578	43440	17089	10998	7706	2454
	1193	1019	705	1193	1093	797	277	382	310	149
	88	54	0	0	0	0	0	48	0	0
2005	1	1	0	2	70	0	0	0	0	0
	0	0	0	0	0	0	0	15	480	9736
	118997	87391	54041	51857	41817	31495	23782	9021	5197	4800
	2206	2090	1049	1075	717	324	221	221	113	36
	46	0	0	0	0	0	0	0	0	0
2006	1	1	0	2	67	0	0	0	0	0
	0	0	0	0	0	0	0	0	3306	
	22629	108391	100915	86929	45290	32101	20844	15954	10699	7506
	3681	2838	1708	1912	511	761	2580	308	132	0
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	0									
2007	1	1	0	2	64	0	0	0	0	0
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	54082	70396	64601	54445	58842	37746	18707	11681	15625	7831
	4841	8448	2259	3735	4278	438	455	117	1226	316
	159	117	0	255	0	0	0	0	0	0
2008	1	1	0	2	98	0	0	0	0	0
	0	0	0	0	0	0	0	0	401	
	13790	175049	148847	104728	76223	44614	33457	14676	13238	
	11255	8194	5767	2706	1499	1369	1236	777	862	222
	113	0	8	586	11	0	0	0	0	0
	0	0								
2009	1	1	0	2	113	0	0	0	0	0
	0	0	0	0	0	0	0	0	146	2887
	104904	107730	93431	55081	50155	25947	30223	16007	15940	
	12696	7388	6801	2355	683	4323	91	486	955	1257
	337	1781	108	108	0	0	0	0	0	0
	0									
2010	1	1	0	2	98	0	0	0	0	0
	0	0	0	0	0	0	0	0	40	3168
	80969	65663	100554	56013	63911	49857	14519	12059	8624	6881
	7079	4950	4215	3011	2984	2604	1229	1072	1059	335
	302	410	358	254	127	0	0	0	0	0
2011	1	1	0	2	103	0	0	0	0	0
	0	0	0	0	0	0	0	0	82	3514
	42567	46238	51629	63594	50320	59307	31597	27273	18416	
	13379	6216	7016	3569	5620	2394	1025	2151	1077	718
	1327	289	86	0	0	0	0	0	0	0
	0									

2012	1	1	0	2	114	0	0	0	0	0
	0	0	0	0	0	0	0	0	2232	
	12451	100744	129415	87343	57287	33655	19594	22391	21406	
	19679	17983	11586	10398	8571	5215	3351	2452	2792	1025
	865	521	499	410	0	0	0	0	0	0
	0	0								
2013	1	1	0	2	131	0	0	0	0	0
	0	0	0	0	0	0	0	209	2114	
	10865	65525	91135	87003	60752	37589	32577	21034	21530	
	19731	23574	19268	7202	10270	6993	3741	2360	1532	4060
	682	1944	0	189	108	0	94	0	13	0
	0	0								
2014	1	1	0	2	112	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	6148
	35572	63509	72703	59672	41257	30908	22976	23194	26987	
	29244	29658	26334	18487	13060	8110	4222	5397	3089	1889
	728	782	170	0	0	119	0	0	0	0
	0									
2015	1	1	0	2	106	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	447
	4572	11392	19597	20814	23420	24390	16553	13885	13474	9817
	7921	9512	10880	7587	8106	5534	4016	2369	2641	904
	914	114	0	15	15	0	0	0	0	0
2016	1	1	0	2	173	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	163	4099	10482	17250	17315	19330	20485	19902	
	18238	13268	9349	8157	4956	3303	2631	1559	2401	793
	694	195	144	275	0	17	0	0	0	0
	0									
2002	1	1	0	1	38	0	0	0	0	0
	0	0	0	0	0	0	0	27949	10487	5244
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2003	1	1	0	1	87	0	0	0	0	0
	0	0	0	0	483	1450	38	1161	19658	
	14442	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									
2005	1	1	0	1	85	0	0	0	0	0
	0	0	0	0	0	0	1761	3638	2873	5890
	0	0	0	0	0	0	0	0	0	
	47395	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									
2006	1	1	0	1	123	0	0	0	0	0
	0	0	1989	1989	970	4082	11941	11873	65761	9769
	2121	0	0	0	0	0	3930	0	0	0
	0	1989	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2007	1	1	0	1	292	0	0	0	0	0
	0	0	0	139	16209	38950	34826	52638	16367	5406

	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0
2008	1	1	0	1	236	0	0	0	0	0
	0	0	0	0	0	0	588	4964	4442	7503
	0	0	0	0	0	0	0	0	0	24
	0	207	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2009	1	1	0	1	169	0	0	0	0	
	12159	12159	133744	206695	148028	36655	26406	2813	7222	
	29651	2534	29	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2010	1	1	0	1	146	0	0	0	0	0
	0	0	8736	0	10295	23448	23056	29348	47848	9498
	262	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2011	1	1	0	1	156	0	0	0	0	0
	0	0	0	0	0	229	2580	5681	43621	2832
	71	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2012	1	1	0	1	179	0	0	0	0	0
	0	0	0	410	553	1275	2410	18434	25801	
	22077	173	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									
2013	1	1	0	1	192	0	0	0	0	0
	0	1655	1655	0	0	0	332	2753	7035	2196
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2014	1	1	0	1	231	0	0	0	0	0
	0	0	0	0	0	0	2163	1082	2106	1461
	0	0	2827	0	0	0	0	0	0	0
	0	0	0	802	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2015	1	1	0	1	183	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	9742	653	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2016	1	1	0	1	69	0	0	0	0	0
	0	0	0	0	909	699	440	3125	5997	
	10216	15490	21190	9250	1954	2269	300	232	87	25
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									

2017	1	1	0	1	1	0	0	0	0	0
	0	0	0	0	0	0	8.71	43.54	39.18	
	39.18	52.24	95.77	95.77	8.71	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									
1985	1	2	0	2	19	0	0	0	0	0
	0	0	0	0	0	2822	5368	5711	5594	1624
	2170	3688	1284	1590	1002	2424	1123	1485	1669	1171
	457	143	443	207	139	325	7	14	0	125
	257	375	0	0	0	0	0	0	0	0
1986	1	2	0	2	31	0	0	0	0	0
	0	0	0	0	32	59	461	1123	2607	2174
	3118	1579	1540	963	1083	1435	1868	2033	1350	1721
	863	741	621	539	681	351	392	254	177	177
	59	0	0	0	0	0	0	0	0	0
1987	1	2	0	2	69	0	0	0	0	0
	0	0	0	0	0	26	102	245	658	757
	1024	924	1630	497	1079	214	461	358	806	1122
	717	526	431	172	98	77	97	562	44	240
	46	183	17	28	39	7	4	0	0	4
1988	1	2	0	2	53	0	0	0	0	0
	0	0	0	0	0	0	24	838	4597	4578
	3030	1744	2166	2108	1304	1295	1215	747	740	481
	841	630	651	884	398	429	308	311	156	52
	59	61	24	169	0	0	0	0	0	0
1989	1	2	0	2	26	0	0	0	0	0
	0	0	0	0	0	0	0	276	630	
	21750	21856	999	366	259	183	24	75	49	75
	235	420	235	231	429	169	328	210	50	185
	25	93	0	0	0	0	0	0	0	0
	0									
1990	1	2	0	2	22	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	119
	164	474	533	1063	1380	1324	1085	967	760	769
	414	494	627	345	277	266	190	196	0	196
	156	74	0	74	0	0	0	0	0	0
1991	1	2	0	2	53	0	0	0	0	0
	0	0	0	0	0	0	0	10	10	1811
	3158	2495	860	591	628	1053	1530	1536	1440	1344
	1062	1067	1756	1191	1411	2280	1280	1312	1273	1286
	565	556	109	256	0	0	0	0	0	0
1992	1	2	0	2	111	0	0	0	0	0
	0	0	0	44	88	0	0	0	3	616
	3464	2977	2124	1332	974	719	557	446	654	523
	499	697	343	286	264	525	228	222	231	176
	172	149	59	13	44	21	0	0	0	0
1993	1	2	0	2	123	0	0	0	0	0
	0	0	7	7	4	11	331	1975	1314	2175
	5307	5933	4077	3082	2857	2235	1507	1104	1531	1073
	1688	1991	2262	999	1125	1423	887	547	662	727
	606	176	128	20	0	5	24	0	0	0

1994	1	2	0	2	155	0	0	0	0	0
	0	0	0	0	0	0	0	53	2507	
	17514	41410	36295	20278	13387	7327	5906	4144	1898	2142
	2831	1407	3143	2615	1872	1361	1706	787	194	525
	59	253	543	408	15	27	0	0	0	0
	0									
1995	1	2	0	2	107	0	0	0	0	0
	0	0	37	147	73	73	37	73	110	4051
	14846	32436	33924	23719	10655	6757	4376	2709	2763	2189
	1069	2014	1888	2907	2051	2210	2218	898	2550	1295
	142	10	25	253	0	0	0	0	0	0
1996	1	2	0	2	106	0	0	0	0	0
	0	0	24	24	0	0	0	0	0	3204
	11374	8560	13522	18431	17622	9343	7156	4070	2591	2349
	2779	1182	937	1737	889	1512	685	1409	914	835
	748	177	178	0	0	0	0	0	0	0
1997	1	2	0	2	137	0	0	0	0	0
	0	0	14	29	58	29	100	138	533	1294
	7827	7802	9038	11155	12767	14218	11620	7425	4019	2324
	1931	1348	753	768	755	1027	1130	655	463	407
	330	143	28	94	0	0	0	0	0	0
1998	1	2	0	2	111	0	0	0	0	0
	0	0	0	0	731	1269	1079	1366	786	676
	5281	7589	10236	9821	10320	8341	9011	6339	7604	4291
	3777	2994	1642	1015	892	741	854	435	545	354
	295	86	144	50	0	0	0	0	0	0
1999	1	2	0	2	149	0	0	0	0	0
	0	0	0	104	260	122	177	602	1074	1957
	11654	15277	19251	14093	11303	9710	6904	6689	6477	4380
	4305	3643	2446	2370	1599	1327	1026	1015	652	624
	283	93	0	79	66	66	28	0	0	0
2000	1	2	0	2	65	0	0	0	0	0
	0	0	0	0	0	0	0	16	18	138
	5880	5954	7621	5425	4950	3902	2189	1791	1704	1245
	1306	1464	1074	860	647	172	260	50	199	68
	64	0	155	0	0	0	0	0	0	0
2001	1	2	0	2	114	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	246
	4393	4273	5531	7145	5337	4579	2859	2679	1560	1386
	1932	1651	1315	1332	529	635	247	220	185	200
	70	44	89	70	0	35	0	0	0	0
2002	1	2	0	2	145	0	0	0	0	0
	0	0	0	0	0	0	0	0	85	1113
	4776	4791	4551	5657	7479	6871	5474	3452	2449	2632
	2723	1873	1572	792	1243	909	446	523	394	396
	171	180	85	24	0	0	0	0	0	0
2003	1	2	0	2	90	0	0	0	0	0
	0	0	0	0	0	0	0	12	12	347
	6738	7562	8447	7163	6892	5129	4649	3693	3070	1752
	1639	1094	974	609	580	388	315	191	119	266
	8	107	0	0	0	0	0	0	0	0

2004	1	2	0	2	69	0	0	0	0	0
	0	0	0	0	0	0	0	0	151	114
	3383	4778	7305	7164	6298	5551	4972	4272	3418	3519
	1990	1623	1259	1182	957	1195	511	161	429	124
	3	136	0	0	0	0	0	0	0	0
2005	1	2	0	2	25	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	30
	1459	5096	5733	5562	5847	2889	2587	1756	2391	2107
	2111	1980	2538	812	1071	42	400	849	261	163
	142	0	240	0	0	0	0	0	0	0
2006	1	2	0	2	67	0	0	0	0	0
	0	0	0	0	0	0	0	0	74	0
	3969	12293	12638	14461	14923	10989	8786	9345	5063	4132
	4038	4524	2755	1619	2088	621	794	551	244	169
	560	344	54	100	0	0	0	0	0	0
2007	1	2	0	2	31	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1136
	5131	14565	15142	14050	12606	10768	12287	8705	5167	6074
	4873	3812	4817	4253	2142	3384	1247	1252	0	747
	487	0	0	24	24	24	0	0	0	0
2008	1	2	0	2	30	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	313
	4013	11689	16359	18034	18687	12444	10441	7197	13773	7484
	3684	3598	3289	2458	2440	303	506	318	615	591
	0	0	200	0	0	0	0	0	0	0
2009	1	2	0	2	19	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	74
	8613	14610	12252	18429	15522	11032	9124	7768	5868	4579
	4902	2018	3718	2757	1475	1029	814	667	147	520
	299	74	0	0	0	0	0	0	0	0
2010	1	2	0	2	41	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	2315	16065	30120	30121	40653	24649	10232	6746	3421	2913
	2137	1626	1675	507	760	539	302	598	331	222
	56	0	56	28	0	0	0	0	0	0
2011	1	2	0	2	56	0	0	0	0	0
	0	0	0	0	0	0	0	0	12	180
	2327	7968	10975	13369	10926	11254	10787	9886	6722	6716
	4301	3064	2450	2410	2342	1525	625	501	297	251
	228	145	102	69	0	0	0	0	0	0
2012	1	2	0	2	100	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	520
	4350	11740	12483	14279	12748	12865	7284	13932	9586	9411
	10724	5622	4735	2099	2450	2478	1173	566	675	137
	394	14	0	0	0	0	0	0	0	0
2013	1	2	0	2	42	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	569
	6040	14247	17604	17459	11704	10487	7481	10703	9458	9034
	6570	6686	5108	5206	1152	1560	1394	1065	555	742
	507	292	244	0	0	0	0	0	0	0
2014	1	2	0	2	73	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	242

	4676	10891	13762	25710	20762	19882	13868	10537	10014	9735
	8784	8504	6874	5473	3441	2491	1627	627	279	566
	190	12	161	0	0	0	0	0	0	0
2015	1	2	0	2	79	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	56
	673	2159	6646	13933	16753	16672	16306	12497	10026	7007
	7775	5112	4352	4358	4486	2297	1991	1524	740	501
	523	15	104	15	78	0	0	0	0	0
2016	1	2	0	2	110	0	0	0	0	0
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	0	212	1973	9062	15595	13444	13398	12345	12837	
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	1115	183	183	72	0	0	0	0	0	0
	0									
1985	1	-3	0	2	2	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0
1987	1	-3	0	2	1	0	0	0	0	0
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1988	1	-3	0	2	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
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	145	76	76	0	76	228	152	76	76	0
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1989	1	-3	0	2	4	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
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	235	401	306	421	532	207	140	85	69	0
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	0	0	0	0	435	2111	2590	1683	720	820
	0	0	0	56	224	56	0	279	112	56
	56	0	56	0	0	0	0	0	0	0
1992	1	-3	0	2	2	0	0	0	0	0
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	0	0	0	59	20	277	138	296	692	415
	1502	573	217	158	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
1995	1	-3	0	2	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	1629	1303	1303	1629	326	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0
1996	1	3	0	2	67	0	0	0	0	0
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	60	4942	11074	20191	14350	12533	10412	5550	3274	417

	980	596	98	204	196	588	490	98	0	98
	0	98	0	0	0	0	0	0	0	0
1998	1	3	0	2	46	0	0	0	0	0
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	129	4038	7185	3523	8141	13079	7721	8577	1929	5980
	433	673	902	199	392	352	41	117	240	234
	117	0	234	117	117	0	0	0	0	0
1999	1	3	0	2	122	0	0	0	0	0
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	1227	4512	5855	13377	17206	19594	15317	13967	14170	9191
	11296	9324	4411	2947	961	1097	1251	941	237	430
	0	237	474	27	0	0	0	0	0	0
2000	1	3	0	2	48	0	0	0	0	0
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	180	755	1873	2069	2545	2801	3193	2432	2263	2199
	3200	2323	1452	1193	812	443	279	248	195	63
	42	11	21	11	11	0	0	0	0	0
2001	1	3	0	2	180	0	0	0	0	0
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	660	1911	5559	5737	9292	8880	7489	7173	4855	3800
	3923	2801	2684	2456	1644	598	774	215	355	80
	42	6	22	0	6	0	0	0	0	0
2002	1	3	0	2	25	0	0	0	0	0
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	60	83	632	2074	6855	13290	4344	8459	6963	3175
	3608	4927	3119	2214	1583	1856	1065	946	344	163
	128	12	12	0	0	0	0	0	0	0
2003	1	3	0	2	30	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	6845
	9901	17114	23691	17034	15347	9762	6692	5434	3443	2193
	1503	941	785	974	378	378	345	0	0	95
	43	43	43	0	0	0	0	0	0	0
2004	1	3	0	2	44	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	535
	2809	6208	12248	12365	8469	13915	17395	19369	4008	9317
	288	1054	1196	1196	566	677	278	343	167	56
	56	0	0	0	0	0	0	0	0	0
2005	1	3	0	2	79	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	173	785	3157	6929	9226	11041	10516	6448	3185	2440
	1366	1541	794	494	311	311	92	103	22	46
	22	0	0	0	0	0	0	0	0	0
2006	1	3	0	2	28	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	106	741	1904	2328	2116	635	952	529	423	529
	106	106	106	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
2007	1	3	0	2	120	0	0	0	0	0
	0	0	0	0	0	0	0	0	18	37
	320	883	2096	2641	5049	4236	3881	2081	2455	1652
	906	619	617	373	150	150	113	56	37	75
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2008	1	3	0	2	68	0	0	0	0	0
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	135	542	993	1095	1112	1005	1319	1199	1169	1206
	722	709	446	362	229	120	75	17	10	7
	9	2	2	7	0	0	0	0	0	0
2009	1	3	0	2	139	0	0	0	0	0
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	81	239	690	1020	1615	1163	827	967	510	227
	99	183	83	96	39	41	21	20	3	4
	10	4	0	0	0	0	0	0	0	0
2010	1	3	0	2	43	0	0	0	0	0
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	2147	3259	5121	5036	3218	3657	2543	962	1850	1217
	755	1023	384	180	178	197	100	50	17	33
	0	0	17	0	0	0	0	0	0	0
2011	1	3	0	2	100	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	293	1045	4271	4583	11310	8588	9653	9609	7336	3924
	3130	2508	2382	1785	925	934	312	293	0	0
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2012	1	3	0	2	141	0	0	0	0	0
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	3001	2588	4530	5537	5034	7019	4509	4023	4008	1503
	1589	587	644	71	57	43	71	100	43	43
	29	57	0	0	0	0	0	0	0	0
2000	1	4	0	2	62	0	0	0	0	0
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	34932	85866	126730	102836	80478	93344	80934	55399	52948	
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	2345	2595	2102	888	1021	548	123	0	0	0
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	17962	19809	68920	76594	98008	109595	106857	77694	57055	
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	5617	3275	1356	297	783	112	148	0	0	0
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2004	1	4	0	2	122	0	0	0	0	0
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	78811	127801	124051	227214	282390	243107	188494	126685	72581	
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	29872	97890	128022	231750	266905	344681	270532	239265	169478	
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	179130	285704	217657	178250	196868	289998	285451	263272	200874	
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	39335	102714	146272	145122	164011	130859	100043	99210	75929	
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	13885	57121	87842	128838	187586	201447	199487	194697	145447	
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	85760	172510	140273	147895	162333	180752	158490	130759	107214	
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	2313	1540	1134	282	451	29	27	0	0	0
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	29667	88507	149070	146130	123170	140677	127136	116842	99156	

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2014	1	4	0	2	202	0	0	0	0	0
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	33532	68262	74871	82684	51365	61292	39844	38109	29929	
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	44175	75546	93273	115713	122460	95208	59668	51436	37860	
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2016	1	4	0	2	231	0	0	0	0	0
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2009	1	4	0	1	65	0	23785	77757	646	0
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	273125	9052	437	0	0	0	0	0	0	0
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2010	1	4	0	1	98	0	0	0	0	0
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2012	1	4	0	1	128	8406	89382	89194	24097	
	13076	8406	934	0	0	934	0	0	60149	
	136319	128793	0	0	0	4397	0	0	0	0
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2014	1	4	0	1	18	0	0	0	0	0
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2015	1	4	0	1	33	0	0	0	0	0
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2016	1	4	0	1	433	0	0	0	0	0
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	59343	27178	70823	30032	828	1173	1173	1242	621	1104
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	1809	1663	4980	2748	14600	18846	12438	26056	33015	
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	42835	62006	30265	16449	44855	18445	2471	13758	17915	8342
	2622	0	40	2	5469	0	0	0	0	0
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	18463	0	6106	0	6106	23906	0	17254	17254	
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	0	0								
1993	1	8	0	0	21	0	0	0	0	0
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1994	1	8	0	0	19	0	0	0	0	0
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	79319	77545	139680	69887	157500	113756	52799	63325	37992	

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	21222	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	10254	42156	199875	248028	
	445903	469290	406992	271169	77307	56211	109682	49306	13620	
	13620	0	25037	27240	13620	13620	0	0	0	
	11417	0	26697	0	0	0	0	0	0	0
	0	0	0							
1999	1	8	0	0	37	0	0	0	0	0
	0	0	0	18433	15128	83225	167646	146928	90595	
	177558	153662	195992	214407	105858	79810	47256	78075	7863	
	17639	0	9059	0	9059	0	15018	0	0	0
	0	0	0	0	0	9059	0	0	0	0
	0	0								
2000	1	8	0	0	36	0	0	0	0	0
	0	0	18644	65257	62040	125296	417455	440978	309620	
	338993	204879	181687	95559	108703	70962	23940	21506	14766	0
	24695	0	14306	0	9307	13096	0	9307	0	0
	0	0	0	0	0	0	0	0	0	0
	0									
2001	1	8	0	0	39	0	0	0	0	0
	0	0	0	0	59740	413187	767358	518235	300493	
	248669	158653	247952	66992	125042	43191	37193	10236	24597	0
	14837	24648	13083	52462	0	0	12053	0	0	
	12053	0	0	0	0	0	0	0	0	0
	0	0								
2002	1	8	0	0	44	0	0	0	0	0
	0	0	0	0	10739	67655	197986	381355	832988	
	623508	439729	380196	270697	189153	102893	112164	50660	44892	
	16171	27189	21612	15932	12167	0	27484	12167	25511	0
	0	9579	0	0	0	0	0	0	0	0
	0	0								
2003	1	8	0	0	41	0	0	0	0	0
	0	0	0	22663	13218	161174	795498	720874	802826	

	1375758	1218315	1251975	623889	464021	274147	207776	203176	72670	
	136756	185043	89875	52508	26254	27514	0	13127	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2004	1	8	0	0	44	0	0	0	0	0
	0	0	0	0	2692	0	122879	403673	714884	
	730822	416792	287359	324966	129278	137035	115126	31042	39375	
	29156	18125	9347	0	61811	2692	2692	9347	0	0
	0	0	0	0	9347	0	0	0	0	0
	0	0								
2005	1	8	0	0	40	0	0	0	0	0
	0	0	0	15565	0	210994	418270	315562	267295	
	354515	215506	225666	181642	106404	138927	146271	109108	98370	
	34142	9487	52772	51553	21543	10751	10751	0	0	
	10223	0	0	0	0	0	0	0	0	0
	0	0	0							
2006	1	8	0	0	36	0	0	0	0	0
	0	0	0	0	9814	197122	866753	893641	788190	
	1120577	531053	311464	137430	190156	96298	71441	84223	86273	
	31873	22996	25308	19628	9814	3032	0	9814	0	0
	11099	0	0	0	0	0	0	0	0	0
	0	0								
2007	1	8	0	0	33	0	0	0	0	0
	0	0	0	0	0	47391	407308	386452	394375	
	609358	479157	314000	219897	169994	170481	111148	80056	57131	
	123245	25737	18311	0	11929	0	10662	5331	19351	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2008	1	8	0	0	40	0	0	0	0	0
	0	0	0	10729	52876	128066	266412	229414	731914	
	1661470	931172	880632	758996	224765	208707	112521	79753	13259	
	72807	14967	28587	19628	0	0	0	42166	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2009	1	8	0	0	26	0	0	0	0	0
	0	0	0	0	0	21413	77225	253598	386804	
	279160	234313	217371	238780	238652	168707	110777	82775	99010	
	56555	38480	0	21413	12158	0	0	0	12249	0
	0	15256	0	0	0	0	0	0	0	0
	0	0								
2010	1	8	0	0	30	0	0	0	0	0
	0	0	0	0	0	20661	79020	106240	232673	
	118288	117886	316567	207944	97593	110810	191255	62479	14580	
	62090	0	22711	0	14580	0	14580	0	0	0
	0	14580	0	0	0	0	0	0	0	0
	0	0								
2011	1	8	0	0	27	0	0	0	0	0
	0	0	0	0	0	13881	0	45451	95055	
	204438	227355	208472	118040	120428	68027	88143	90627	60054	
	47411	9869	0	33403	36907	46184	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								

2012	1	8	0	0	25	0	0	0	0	0
	0	0	0	0	0	29922	15009	161369	400458	
	247182	200887	183315	84361	197280	103031	86442	77382	31957	
	43195	19956	39781	11851	40610	19956	20305	20305	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2013	1	8	0	0	19	0	0	0	0	0
	0	0	0	0	0	42825	113195	62476	113528	
	127750	96177	135950	70592	33717	44279	61410	11237	17382	
	17382	48087	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	0								
2014	1	8	0	0	20	0	0	0	0	0
	0	0	0	0	0	0	0	0	68544	
	62919	72216	235064	138177	171873	205729	78929	0	0	0
	38360	25884	0	0	0	0	28103	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0									

AGE COMPOSITION SET-UP

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17 #_N_age_bins

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

AGEING ERROR

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1 #_N_ageerror_definitions

0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5
	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5	29.5	30.5
0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95	1.05
	1.15	1.25	1.35	1.45	1.55	1.65	1.75	1.85	1.95	2.05
	2.15	2.25	2.35	2.45	2.55	2.65	2.75	2.85	2.95	3.05

AGE COMPOSITION DATA

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125 #_N_Agecomp_obs

1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths (set to 3 for cond'l age-at-length?)

0 #_combine males into females at or below this bin number

#Yr Seas Flt/Svy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

1985	1	1	0	2	1	-1	-1	131	0	0
	65	11844	30828	6121	9692	1240	3914	9713	2454	2581
	1320	343	841	286	892					
1986	1	1	0	2	1	-1	-1	46	0	0
	0	15673	20303	18759	3453	7662	704	3197	10503	1833
	1403	2889	1222	1688	3595					
1987	1	1	0	2	1	-1	-1	113	0	0
	0	439	30263	58458	13753	2095	2437	656	726	5731
	2565	1889	761	817	2796					
1988	1	1	0	2	1	-1	-1	35	0	0
	0	1930	20862	54472	41710	12803	1721	2315	780	451
	5503	2024	1312	801	2589					
1989	1	1	0	2	1	-1	-1	299	0	0
	33394	5411	1223	7659	43911	26891	9002	3076	2901	1878
	2896	8914	1499	1286	3436					
1990	1	1	0	2	1	-1	-1	133	0	0
	0	3035	2503	3770	16047	31459	21020	5042	2186	1463
	846	1100	4837	353	2703					
1991	1	1	0	2	1	-1	-1	287	0	0
	1533	6933	36938	2381	1283	6576	18064	16248	7033	589
	2617	2321	480	6659	3674					
1992	1	1	0	2	1	-1	-1	202	0	0
	0	15982	55550	33557	1183	796	1956	4750	4762	1230
	451	433	139	497	3202					
1993	1	1	0	2	1	-1	-1	218	0	0
	0	657	81429	65981	21858	1351	627	1796	4803	3920
	1500	710	735	475	2347					
1994	1	1	0	2	1	-1	-1	282	0	0
	2	1328	30970	369416	41472	16079	1130	294	2282	5842
	4387	1596	650	646	3717					
1995	1	1	0	2	1	-1	-1	115	0	0
	0	5599	37064	81529	334815	17932	6931	702	415	1046
	3440	3215	1846	2699	2680					
1996	1	1	0	2	1	-1	-1	163	0	0
	191	11473	43831	31632	64618	173733	8235	3622	216	315
	454	1881	1688	534	1784					
1997	1	1	0	2	1	-1	-1	137	0	0
	0	2490	8501	64000	45238	39229	145407	8105	4456	632
	640	294	2689	1712	2235					
1998	1	1	0	2	1	-1	-1	165	0	0
	0	1103	44997	49461	69489	25366	15136	41057	2671	860
	96	96	385	623	811					
1999	1	1	0	2	1	-1	-1	218	0	0
	241	82	80414	146338	43841	28582	9612	6192	18072	1112
	729	40	270	97	830					
2000	1	1	0	2	1	-1	-1	395	0	0
	0	9528	2584	151515	72747	11772	11046	4992	4636	8323
	818	184	14	55	643					

2001	1	1	0	2	1	-1	-1	286	0	0
	614	11085	92408	29064	105169	25329	7388	8742	5811	8136
	7522	804	768	69	759					
2002	1	1	0	2	1	-1	-1	36	0	0
	338	11495	43605	240476	16779	67647	16021	7450	8022	2682
	3842	10166	645	193	568					
2003	1	1	0	2	1	-1	-1	154	0	0
	0	5698	75254	70415	154267	8719	38901	14072	4789	3196
	2260	1599	3937	937	756					
2004	1	1	0	2	1	-1	-1	94	0	0
	0	4406	38270	214112	76652	95133	2733	12227	4039	1583
	994	802	263	1029	221					
2005	1	1	0	2	1	-1	-1	76	0	0
	0	18910	135210	89202	124422	33796	30175	3112	7357	1390
	1123	363	173	650	842					
2006	1	1	0	2	1	-1	-1	44	0	0
	0	20497	141335	144890	54069	56281	17344	24148	2207	3475
	2277	859	210	188	1433					
2007	1	1	0	2	1	-1	-1	185	0	0
	0	955	33606	169272	96625	44423	34061	12877	14366	
	11530	4527	1621	11	254	428				
2008	1	1	0	2	1	-1	-1	89	0	0
	0	9338	110875	296983	139083	47617	19838	17332	8660	6128
	852	793	988	317	824					
2009	1	1	0	2	1	-1	-1	162	0	0
	0	2659	73056	169969	172602	64997	19002	14443	9064	8631
	3610	2235	1302	0	249					
2010	1	1	0	2	1	-1	-1	73	0	0
	0	319	77100	155258	118179	78410	28938	11821	6979	6043
	2645	2083	2273	534	1663					
2011	1	1	0	2	1	-1	-1	78	0	0
	0	845	28630	124625	92582	71094	54338	31775	10438	
	11227	6347	2933	2203	675	1692				
2012	1	1	0	2	1	-1	-1	101	0	0
	0	1620	14135	166965	219883	61319	39609	31669	15268	9427
	4092	3864	2546	538	930					
2013	1	1	0	2	1	-1	-1	11	0	0
	0	0	45016	60547	182858	117821	33448	30222	22727	
	17473	11825	2908	2687	2429	2133				
2014	1	1	0	2	1	-1	-1	104	0	0
	0	6622	31923	107001	58412	114826	78809	38859	27037	
	30548	19853	5152	1776	1857	1487				
2015	1	1	0	2	1	-1	-1	81	0	0
	0	50	3716	20172	45807	36830	63272	35025	17302	
	12685	10431	2917	7265	7308	966				
2016	1	1	0	2	1	-1	-1	94	0	0
	0	0	1591	7863	13991	31088	24925	40386	24807	
	10618	8218	4788	1960	2098	1528				

1985	1	-2	0	2	1	-1	-1	5	0	0
	0	9225	11491	3441	5902	891	1113	5133	1176	694
	913	46	122	134	936					
1986	1	2	0	2	1	-1	-1	53	0	0
	0	577	8939	3343	933	2354	358	758	5428	960
	871	953	573	645	1307					
1987	1	2	0	2	1	-1	-1	60	0	0
	0	108	1052	3719	2132	581	477	432	523	1578
	845	211	167	179	1187					
1988	1	2	0	2	1	-1	-1	92	0	0
	0	33	1751	13389	5067	2398	551	1014	209	456
	1863	895	715	523	977					
1989	1	2	0	2	1	-1	-1	66	0	0
	22	0	538	8171	36046	1842	371	104	208	58
	215	1040	115	87	334					
1990	1	2	0	2	1	-1	-1	249	0	0
	0	305	82	185	1284	3456	2407	897	357	369
	193	242	1261	81	828					
1991	1	2	0	2	1	-1	-1	281	0	0
	0	131	8420	471	177	792	4927	4024	1842	89
	1229	1685	367	4831	2887					
1992	1	2	0	2	1	-1	-1	357	0	0
	0	1195	5473	5267	294	269	518	1193	1633	563
	130	195	169	143	1411					
1993	1	2	0	2	1	-1	-1	418	0	0
	16	526	11652	11776	7569	590	289	931	3941	3344
	1367	663	703	643	3789					
1994	1	2	0	2	1	-1	-1	287	0	0
	0	71	4059	119784	18540	9393	943	173	1754	5414
	5570	1205	639	274	2790					
1995	1	2	0	2	1	-1	-1	213	0	0
	0	486	6943	21979	97509	7380	5313	480	699	831
	5684	3696	1936	840	4733					
1996	1	2	0	2	1	-1	-1	166	0	0
	0	210	8804	12487	15338	57127	4566	4979	127	510
	364	2521	1573	1300	2346					
1997	1	2	0	2	1	-1	-1	157	0	0
	59	454	3102	15613	11415	8287	50819	2853	1635	557
	354	243	2195	1065	1570					
1998	1	2	0	2	1	-1	-1	145	0	0
	0	3676	8366	10920	22630	10485	6452	28231	2949	1091
	138	196	793	1381	1254					
1999	1	2	0	2	1	-1	-1	184	0	0
	479	255	25158	37306	13589	13697	5288	5001	20522	1669
	2038	247	777	315	3314					
2000	1	2	0	2	1	-1	-1	237	0	0
	0	421	294	19380	12402	2696	3285	1476	1248	4697
	330	258	16	88	559					

2001	1	2	0	2	1	-1	-1	411	0	0
	54	471	7385	1392	17864	7702	2027	3239	1685	1761
	3774	440	301	27	420					
2002	1	2	0	2	1	-1	-1	495	0	0
	30	729	2609	14173	2686	17358	7757	2621	5179	1463
	1766	3687	322	101	180					
2003	1	2	0	2	1	-1	-1	236	0	0
	0	80	7166	7917	25014	2167	10164	3262	1473	982
	796	681	1704	186	166					
2004	1	2	0	2	1	-1	-1	152	0	0
	0	279	1697	13884	8601	17310	2398	6365	3626	1181
	1189	1172	406	2243	143					
2005	1	2	0	2	1	-1	-1	127	0	0
	0	621	2669	5059	14699	5529	6985	589	5697	1845
	236	1307	33	189	606					
2006	1	2	0	2	1	-1	-1	87	0	0
	0	44	16121	35990	13714	22306	5794	12717	1644	3135
	1258	305	358	1016	734					
2007	1	2	0	2	1	-1	-1	55	0	0
	0	22	6611	31578	28396	14511	17834	8499	10951	5163
	3121	5119	85	344	485					
2008	1	2	0	2	1	-1	-1	96	0	0
	0	199	5010	27319	42071	21561	12265	12566	5458	4960
	1372	1032	3431	198	992					
2009	1	2	0	2	1	-1	-1	38	0	0
	0	315	8415	19843	33661	25695	12017	9320	5021	5371
	4748	811	1075	0	0					
2010	1	2	0	2	1	-1	-1	51	0	0
	0	814	7029	45515	54766	39716	15835	5147	2395	2910
	706	522	359	81	277					
2011	1	2	0	2	1	-1	-1	34	0	0
	0	8	5209	11538	24667	19293	16668	13032	4947	6066
	2695	1941	2187	522	657					
2012	1	2	0	2	1	-1	-1	50	0	0
	0	91	1695	18362	28593	23507	22946	17909	10199	7725
	2994	2672	2158	596	820					
2013	1	2	0	2	1	-1	-1	91	0	0
	0	0	1187	6979	35135	32251	18057	14762	10333	
	10543	6106	3730	2886	1957	1938				
2014	1	2	0	2	1	-1	-1	41	0	0
	0	980	4985	26081	20743	39548	28357	15323	12440	
	12413	8018	4889	1976	1673	1322				
2015	1	2	0	2	1	-1	-1	64	0	0
	0	6	1834	5941	23369	22221	31442	19014	10344	8210
	7036	2504	3136	744	798					
2016	1	2	0	2	1	-1	-1	69	0	0
	0	0	742	7020	11858	20142	15479	25838	13362	7406
	5904	4674	2548	3894	2567					

1996	1	3	0	2	1	-1	-1	67	0	0
	0	0	289	796	3892	71666	5583	1648	21	334
	154	622	485	199	559					
1998	1	3	0	2	1	-1	-1	50	0	0
	0	0	245	5979	11845	8553	8135	25138	2517	345
	93	53	119	893	569					
1999	1	3	0	2	1	-1	-1	50	0	0
	0	0	2983	18409	15106	27147	13818	18060	43097	4389
	1686	324	387	308	2689					
2000	1	3	0	2	1	-1	-1	50	0	0
	0	15	60	2476	7587	3270	4497	1459	2830	7077
	634	174	39	96	420					
2001	1	3	0	2	1	-1	-1	50	0	0
	0	0	179	899	19777	20290	7042	5268	3124	2845
	9666	857	636	123	261					
2002	1	3	0	2	1	-1	-1	50	0	0
	0	3	37	2380	1578	24087	9693	6297	5978	450
	5664	9215	0	0	530					
2003	1	3	0	2	1	-1	-1	50	0	0
	0	0	2689	10619	39257	7971	40551	10293	3162	3254
	618	169	4043	77	281					
2004	1	3	0	2	1	-1	-1	50	0	0
	0	7	1254	12502	14372	48109	3199	20694	8010	353
	1797	1141	91	968	18					
2005	1	3	0	2	1	-1	-1	50	0	0
	0	0	114	2103	15321	14397	17408	1907	5182	0
	1831	99	0	40	599					
2006	1	3	0	2	1	-1	-1	50	0	0
	0	0	227	567	608	4076	1423	3085	254	176
	111	0	0	0	53					
2007	1	3	0	2	1	-1	-1	50	0	0
	0	0	385	2517	7038	5387	6833	2795	1900	631
	807	12	37	19	121					
2008	1	3	0	2	1	-1	-1	50	0	0
	0	45	445	1540	3279	1787	1412	1557	755	960
	30	183	490	0	40					
2009	1	3	0	2	1	-1	-1	50	0	0
	0	0	90	635	2175	2596	843	784	168	298
	173	11	169	0	0					
2010	1	3	0	2	1	-1	-1	50	0	0
	0	9	36	1741	5546	8261	6678	4755	403	3786
	152	294	313	551	50					
2011	1	3	0	2	1	-1	-1	50	0	0
	0	0	255	4397	10231	13640	15909	13642	4424	4233
	2773	1688	1003	264	423					
2012	1	3	0	2	1	-1	-1	50	0	0
	0	0	391	4461	10776	10016	8757	5789	2741	1134
	290	433	143	127	226					

2015	1	-3	0	2	1	-1	-1	50	0	0
	0	0	7	23	85	103	137	30	6	3
	0	0	0	0	0					
2000	1	4	0	2	1	-1	-1	100	0	0
	0	0	9440	222655	273687	139562	79413	47258	43924	
	49293	20207	10767	4925	4927	10901				
2001	1	4	0	2	1	-1	-1	100	0	0
	0	2651	55640	47734	298773	211740	90962	44742	21074	
	39908	36007	17787	4394	6838	8034				
2002	1	4	0	2	1	-1	-1	100	0	0
	0	8114	73892	125531	90294	236147	86108	31151	23025	
	17823	14760	15912	9752	3743	1553				
2003	1	4	0	2	1	-1	-1	100	0	0
	2611	10800	364427	241694	318445	96562	254050	114829	57883	
	26223	19879	14232	18088	6600	4028				
2004	1	4	0	2	1	-1	-1	100	0	0
	3	4	80483	627951	438799	297961	65297	131612	77533	
	25416	14848	14254	13528	7628	5270				
2005	1	4	0	2	1	-1	-1	100	0	0
	0	24195	77794	253455	735235	352182	443765	39104	161572	
	69617	26314	17996	19238	17974	22718				
2006	1	4	0	2	1	-1	-1	100	0	0
	3138	74600	131099	564668	361515	841651	146484	253945	13655	
	132370	84910	22068	6648	6999	16069				
2007	1	4	0	2	1	-1	-1	100	0	0
	0	5307	73224	135809	460583	124606	139879	79978	69214	
	33191	65868	68599	11131	9034	5486				
2008	1	4	0	2	1	-1	-1	100	0	0
	1208	79917	175402	545960	401231	456312	143871	147881	40719	
	57341	17882	35092	12669	5518	6091				
2009	1	4	0	2	1	-1	-1	100	0	0
	315	23355	119979	282754	473020	238022	408951	100487	200417	
	73570	37114	32657	55506	33537	23529				
2010	1	4	0	2	1	-1	-1	100	0	0
	717	1962	39409	221063	515711	411737	437222	200328	172430	
	109342	75421	46461	21880	4806	16480				
2011	1	4	0	2	1	-1	-1	100	0	0
	0	0	6087	172404	252236	312186	303804	314164	125800	
	89188	34465	28352	12942	5585	337				
2012	1	4	0	2	1	-1	-1	100	0	0
	0	406	14357	65157	262593	346334	308183	264012	214803	
	83939	50701	24784	8470	3191	1583				
2013	1	4	0	2	1	-1	-1	100	0	0
	0	60	569	52216	96064	609903	377156	367869	481247	
	245982	158757	43008	21825	14812	11520				
2014	1	4	0	2	1	-1	-1	100	0	0
	0	603	6846	11735	123435	149938	133129	143241	39242	
	39476	12679	7347	3067	198	0				

2015	1	4	0	2	1	-1	-1	100	0	0
	47	1394	20917	116939	139446	125305	191220	88543	67528	
	24658	17551	5046	5387	431	428				
2016	1	4	0	2	1	-1	-1	100	0	0
	24	565	3419	23364	25335	22790	29076	38383	26822	
	18455	4964	3114	1866	381	429				
1986	1	7	0	0	1	-1	-1	15	0	0
	0.27	4.26	1.31	0	0	0	0	0	0	0
	0	0	0	0	0					
1987	1	7	0	0	1	-1	-1	17	0	0
	0.05	0.28	2.27	0	0	0	0	0	0	0
	0	0	0	0	0					
1989	1	7	0	0	1	-1	-1	21	0	0
	6.68	0.37	0	0	0	0	0	0	0	0
	0	0	0	0	0					
1990	1	7	0	0	1	-1	-1	24	0	0
	2.81	1.15	0.02	0	0	0	0	0	0	0
	0	0	0	0	0					
1991	1	7	0	0	1	-1	-1	18	0	0
	3.08	0.21	0.03	0	0	0	0	0	0	0
	0	0	0	0	0					
1992	1	7	0	0	1	-1	-1	35	0	0
	0.95	18.59	0.16	0	0	0	0	0	0	0
	0	0	0	0	0					
1993	1	7	0	0	1	-1	-1	35	0	0
	6.65	3.59	4.39	0	0	0	0	0	0	0
	0	0	0	0	0					
1994	1	7	0	0	1	-1	-1	35	0	0
	3.33	1.84	0.29	0	0	0	0	0	0	0
	0	0	0	0	0					
1995	1	7	0	0	1	-1	-1	36	0	0
	4.83	4.69	0.72	0	0	0	0	0	0	0
	0	0	0	0	0					
1996	1	7	0	0	1	-1	-1	34	0	0
	5.52	0.43	0.11	0	0	0	0	0	0	0
	0	0	0	0	0					
1997	1	7	0	0	1	-1	-1	35	0	0
	33.62	4.52	0.06	0	0	0	0	0	0	0
	0	0	0	0	0					
1998	1	7	0	0	1	-1	-1	36	0	0
	1.22	5.5	0.61	0	0	0	0	0	0	0
	0	0	0	0	0					
1999	1	7	0	0	1	-1	-1	33	0	0
	19.37	0.67	0.87	0	0	0	0	0	0	0
	0	0	0	0	0					
2000	1	7	0	0	1	-1	-1	36	0	0
	6.07	11.35	0.03	0	0	0	0	0	0	0
	0	0	0	0	0					

2001	1	7	0	0	1	-1	-1	33	0	0
	34.42	3.92	1.57	0	0	0	0	0	0	0
	0	0	0	0	0					
2002	1	7	0	0	1	-1	-1	36	0	0
	7.42	3.87	0.4	0	0	0	0	0	0	0
	0	0	0	0	0					
2003	1	7	0	0	1	-1	-1	35	0	0
	8.37	4.6	0.59	0	0	0	0	0	0	0
	0	0	0	0	0					
2005	1	7	0	0	1	-1	-1	35	0	0
	13.12	7.98	0.84	0	0	0	0	0	0	0
	0	0	0	0	0					
2006	1	7	0	0	1	-1	-1	34	0	0
	9.51	9.21	1.02	0	0	0	0	0	0	0
	0	0	0	0	0					
2007	1	7	0	0	1	-1	-1	34	0	0
	3.42	1.78	0.3	0	0	0	0	0	0	0
	0	0	0	0	0					
2008	1	7	0	0	1	-1	-1	36	0	0
	18.52	6.66	0.34	0	0	0	0	0	0	0
	0	0	0	0	0					
2009	1	7	0	0	1	-1	-1	35	0	0
	13.25	6.25	0.33	0	0	0	0	0	0	0
	0	0	0	0	0					
2011	1	7	0	0	1	-1	-1	35	0	0
	2.25	1.39	0.42	0	0	0	0	0	0	0
	0	0	0	0	0					
2013	1	7	0	0	1	-1	-1	35	0	0
	1.34	0.08	0.1	0	0	0	0	0	0	0
	0	0	0	0	0					
2014	1	7	0	0	1	-1	-1	34	0	0
	0.74	0.64	0.02	0	0	0	0	0	0	0
	0	0	0	0	0					
2015	1	7	0	0	1	-1	-1	34	0	0
	6.95	0.44	0.05	0	0	0	0	0	0	0
	0	0	0	0	0					
2016	1	7	0	0	1	-1	-1	35	0	0
	3.75	2.17	0.11	0	0	0	0	0	0	0
	0	0	0	0	0					

MEAN LENGTH OR BODYWEIGHT-AT-AGE

----

0 #_N_MeanSize-at-Age_obs

#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)

samplesize(female-male)

ENVIRONMENTAL DATA

----

0 #_N_environ_variables

0 #_N_environ_obs

GENERALIZED SIZE COMPOSTION DATA

----

0 # N WtFreq methods

TAG-RECAPTURE

----

0 # Do_Tags (0=omit, 1=enter conditional data per manual)

STOCK COMPOSITION

----

0 # no morphcomp data

999 # end of data file marker

Appendix 3

Content of Stock Synthesis Starter file (Starter.SS) used at WKBASS 2018.

#V3.24u

#C Bass initial assessment

BassIVVII.dat

BassIVVII.ctl

0 # 0=use init values in control file; 1=use ss3.par

1 # run display detail (0,1,2)

1 # detailed age-structured reports in REPORT.SSO (0,1)

0 # write detailed checkup.sso file (0,1)

4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)

1 # write to cumreport.sso (0=no,1=like&time-series; 2=add survey fits)

1 # Include prior_like for non-estimated parameters (0,1)

1 # Use Soft Boundaries to aid convergence (0,1) (recommended)

2 # Number of datafiles to produce: 1st is input, 2nd is estimates, 3rd and higher are bootstrap

8 # Turn off estimation for parameters entering after this phase

10 # MCeval burn interval

8 # MCeval thin interval

0 # jitter initial parm value by this fraction

-1 # min yr for sdreport outputs (-1 for styr)

-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs

0 # N individual STD years

#vector of year values

0.0001 # final convergence criteria (e.g. 1.0e-04)

0 # retrospective year relative to end year (e.g. -4)

0 # min age for calc of summary biomass

1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr

1.0 # Fraction (X) for Depletion denominator (e.g. 0.4)

2 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR

4 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates); 4=true F for range of ages

4 15 #COND 10 15 #_min and max age over which average F will be calculated with F_reporting=4

0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt

999 # check value for end of file

Appendix 4

Content of Stock Synthesis Forecast file (Forecast.SS) used at WKBASS 2018. This is not used for creating forecasts yet, but has to be available.

#V3.24U

for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy

2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)

0.35 # SPR target (e.g. 0.40)

0.4 # Biomass target (e.g. 0.40)

#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)

0 0 0 0 0 0

2015 2015 2015 2015 2015 2015 # after processing

1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below

#

1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar

1 # N forecast years

1 # F scalar (only used for Do_Forecast==5)

#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)

-4 0 -4 0

2011 2015 2011 2015 # after processing

1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))

0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)

0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)

0.75 # Control rule target as fraction of Flimit (e.g. 0.75)

3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)

3 #_First forecast loop with stochastic recruitment

0 #_Forecast loop control #3 (reserved for future bells&whistles)

0 #_Forecast loop control #4 (reserved for future bells&whistles)

0 #_Forecast loop control #5 (reserved for future bells&whistles)

2016 #FirstYear for caps and allocations (should be after years with fixed inputs)

0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)

0 # Do West Coast gfish rebuilder output (0/1)

-1 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)

-1 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)

1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below

Note that fleet allocation is used directly as average F if Do_Forecast=4

2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)

Conditional input if relative F choice = 2

Fleet relative F: rows are seasons, columns are fleets

#_Fleet: UKOTB_Nets Lines UKMWT French Other RecFish

0.209288 0.0413269 0.00655029 0.409476 0.0954993 0.23786

max totalcatch by fleet (-1 to have no max) must enter value for each fleet

-1 -1 -1 -1 -1 -1

max totalcatch by area (-1 to have no max); must enter value for each fleet

-1

fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)

0 0 0 0 0 0

#_Conditional on >1 allocation group

allocation fraction for each of: 0 allocation groups

no allocation groups

0 # Number of forecast catch levels to input (else calc catch from forecast F)

-1 # code means to read fleet/time specific basis (2=dead catch; 3=retained catch; 99=F)

Input fixed catch values

#Year Seas Fleet Catch(or_F) Basis

#

999 # verify end of input